The Engineer.

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VOL. CLII.—No. 3953] LONDON: FRIDAY EVENING, OCTOBER 16, 1931 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

The Agent, Eastern BENGAL RAILWAY, Calcutta, invites TENDERS for :—

SCHEDULE 1.—OIL ENGINE GENERATING SETS and SWITCHBOARD complete, required for the Electric Equipment for Relief Trains, B.G. and M.G.

SCHEDULE 2.—FORGED STEEL DIE BLOCKS and DUPLICATE PARTS for Locomotives, Carriages and Wagons.

Forms of Tender obtainable from the Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, at a fee (which will not be returned) of 5s. for each Schedule.

Tenders must provide for the delivery of the stores c.i.f. Calcutta, and for payment in India in rupees. Any Tender which does not comply with these conditions will not be considered.

Tenders must be sent direct to the AGENT, Eastern Bengal Railway, Calcutta, to reach him not later than 23rd November, 1931, for Schedule 1; and 16th December, 1931, for Schedule 2. 7645

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Tuesday, 3rd November, 1931, for LOW-PRESSURE HOT WATER HEATING at "Elmbridge" Telephone Exchange, Surbiton, Surrey.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities, and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 7662

Corporation of Durban (Natal). The Corporation of Durban (Natal) is prepared to receive TENDERS for the SUPPLY and DELIVERY, free on board, of the following :—

THREE-PHASE and SINGLE-PHASE TRANSFORMERS, &c.

To be approved by the Consulting Engineers, Messrs. Merz and McLellan, 32, Victoria-street, Westminster, S.W. 1.

A deposit of £2 2s., returned on receipt of bona fide Tender, will be required.

Specifications can be obtained from, and sealed and endorsed Tenders (in duplicate) must be delivered to, the undersigned on or before Wednesday, 28th October, 1931.

The lowest or any Tender will not necessarily be accepted.

By Order,
WEBSTER, STEEL and CO.,
9, St. Helen's-place, Bishopsgate, E.C. 3.
7644 Agents to the Durban Corporation.

Romford Urban District COUNCIL.
PRIVATE STREET WORKS ACT, 1892.

The above Council invite TENDERS for the MAKING-UP of :—

CROSSWAYS,
BALGORES-CRESCENT,
SQUIRRELS HEATH-AVENUE,
BALGORES-SQUARE,
HARE HALL-LANE.

The plans, sections, and general conditions of contract may be inspected and the specification, bill of quantities and form of Tender obtained on application to Mr. F. G. Beaumont, Engineer and Surveyor, Council Offices, 110, Market-place, Romford, upon payment of a deposit of £2 2s., which will be returned upon receipt of a bona fide Tender and the return of all documents supplied by the Council.

Sealed Tenders, endorsed "Private Street Works," must be delivered to the undersigned not later than Wednesday, the 4th November, 1931.

Any person whose Tender may be accepted for the work will be required to enter into a contract and bond to be prepared by the Clerk to the Council.

The Council do not bind themselves to accept the lowest or any Tender.

CHARLES T. KING,
Clerk to the Council.

Council Offices,
Arcade Chambers,
South-street, Romford,
12th October, 1931. 7655

Tyne Improvement Commission.
CONSTRUCTION OF COAL SHIPPING STAITH NEAR THE WEST END OF NORTHUMBERLAND DOCK.

The Tyne Improvement Commissioners invite TENDERS for the CONSTRUCTION of FOUNDATIONS for a new COAL SHIPPING STAITH in the river at the west end of Northumberland Dock, River Tyne.

The work comprises the sinking and filling with reinforced concrete of steel cylinders, ferro-concrete piling and decking, steel sheet piling, timber fendering and gangways, &c.

Copies of the form of Tender, conditions of contract and specification may be obtained on and after Wednesday, the 21st instant, on application to the undersigned on payment of a deposit of £3 3s., which sum will be returned on receipt of a bona fide Tender.

Persons obtaining copies of the form of Tender, &c., may also obtain copies of the contract drawings from the Engineer-in-Chief, Mr. R. F. Hinumarsh, M. Inst. C.E.

Tenders, in sealed envelopes endorsed "Tender for Foundations" and addressed to the Chairman, Tyne Improvement Commission, Bewick-street, Newcastle-upon-Tyne, must be delivered at the undermentioned offices not later than Noon on Wednesday, the 4th proximo.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
ALBERT BLACKLOCK,
Secretary.

Tyne Improvement Commission Offices,
Bewick-street, Newcastle-upon-Tyne,
16th October, 1931. 7664

Assistant Town Engineer Re- QUIRED by the Borough Council of San Fernando, Trinidad, B.W.I. Age 26 to 32 years, preferably single, to have had recognised training in Mechanical and Electrical Engineering, with thorough knowledge of Diesel oil engine alternating-current plant. Some knowledge of general municipal engineering desirable.

Salary £400 per annum, rising to £500 by annual increments of £25.

Apply to Messrs. PREECE, CARDEW and RIDER, 8-10, Queen Anne's-gate, Westminster, S.W. 1, in writing, stating full particulars of experience and training. 7663

The Engineer

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PUBLIC NOTICES.

City of Nottingham.
APPOINTMENT OF BATHS SUPERINTENDENT.

The Public Baths and Wash-houses Committee invite APPLICATIONS for the APPOINTMENT of BATHS SUPERINTENDENT.

The person appointed will be required to reside at and manage one of the Establishments.

Applicants must have had previous experience of the management of Public Baths and Wash-houses, be well acquainted with the working of Filtration Plants, and a qualified Engineer.

Candidates must not be more than 45 years of age.

The salary will be £450 per annum. In addition, house, coal and light will be provided.

The post will be a designated post under the Local Government and Other Officers' Superannuation Act, 1922, and the successful candidate will be required to pass a medical examination.

Applications (with copies of not more than three recent testimonials), stating age, qualifications, experience, present position, &c. (endorsed "Baths Superintendent"), to be sent to me not later than 31st October, 1931.

W. J. BOARD,
Town Clerk.
The Guildhall, Nottingham. 7665

City of Nottingham.
PUBLIC BATHS AND WASH-HOUSES.

The Public Baths and Wash-houses Committee invite APPLICATIONS for the POSITION of MANAGER of the TURKISH BATHS.

Applicants must have had previous experience of the management of public baths, be a good masseur and have had experience of boiler work, also possess a good knowledge of engineering.

The commencing salary will be £156 per annum.

The post will be a designated post under the Local Government and Other Officers' Superannuation Act, 1922, and the successful candidate will be required to pass a medical examination.

Candidates must not be more than 45 years of age.

Applications (with copies of not more than three recent testimonials), stating age, qualifications, experience and present position (endorsed "Manager, Turkish Baths"), to be sent to me not later than 31st October, 1931.

W. J. BOARD,
Town Clerk.
The Guildhall, Nottingham. 7666

PUBLIC NOTICES.

City of Sheffield.
WATER DEPARTMENT.

ENGINEERING ASSISTANT—GRADE VI.

APPLICATIONS are INVITED for an APPOINTMENT as above, at a commencing salary of £348 per annum, rising, subject to satisfactory service, by two annual increments to a maximum of £400 per annum.

Candidates must be Chartered Civil Engineers or have passed the necessary examinations to qualify for such, be good draughtsmen, and have had experience in the Design, Construction and Maintenance of large Water or analogous Civil Engineering Works.

The appointment is subject to the Local Government and Other Officers' Superannuation Act, 1922, and the selected candidate will be required to pass a medical examination.

Applications, stating age, qualifications and experience, accompanied by copies of three recent testimonials, endorsed "Engineering Assistant," to be sent to me not later than Saturday, the 31st instant.

JOHN K. SWALES,
General Manager and Engineer.
Town Hall, Sheffield,
9th October, 1931. 7652

The Manchester Steam Users' ASSOCIATION.

For the Prevention of Steam Boiler Explosions and for the Attainment of Economy in the Application of Steam, 20, QUAY-STREET, DEANSGATE, MANCHESTER.

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NOTICE TO FOREMEN.

The National Foremen's Asso- CIATION is an Association of Foremen formed to represent them on all questions affecting their supervisory interests.

For full particulars apply, GENERAL SECRETARY, 95, Belgrave-road, Westminster, S.W. 1. 7608

SITUATIONS OPEN.

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State age and forward references.

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Prospects after two years of permanent pensionable post, salary £250 to £350, plus bonus at Civil Service Rates to suitable man. No candidate whose age is outside these limits will be considered.

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ADVERTISER Would Like to Get Into Touch with Engineers of practical experience, capable of WRITING ARTICLES on Machine Tool Work.—Address, 7650, The Engineer Office. 7650 A

AN Important BRITISH COMPANY, Specialising in the manufacture and installation of modern high-efficiency Furnace Plants for all industrial purposes (Metal, Engineering, Glass and Pottery Trades), is able to OFFER a LIBERAL COMMISSION to SALES ENGINEERS who are already calling upon engineering and other concerns, and who are able to effect introductions amongst their existing connections.

Full particulars, ground covered, &c., to be addressed to 7538, The Engineer Office. Correspondence will be dealt with in strict confidence. 7538 A

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ENGINEER WORKING FOREMAN WANTED for general works, provincial district; about 20 hands. One used to Traction and Portable Engines, Repairs, Pumps and Agricultural Work; knowledge of drawing essential. Age 30 to 35. Two recent references (copies only, not returnable). State salary, when disengaged. Good house free.—Address, 7616, The Engineer Office. 7616 A

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WANTED, DRAUGHTSMAN; Punching, Shearing and Heavy Tool Work.

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A Seven-Day Journal

The St. Lawrence Waterway.

LAST Thursday, Mr. Bennett, the Canadian Prime Minister, stated in Ottawa that negotiations between the Governments of the United States and Canada would begin at once with the object of framing a treaty between the two countries regarding the development of the St. Lawrence River. The project involves the deepening of the channel of the Upper St. Lawrence River to a depth of about 27ft. by the construction of dams and the development of a hydro-electric power scheme giving several million horse-power, which would be shared by Canada and the United States. At present the canal system westward from Montreal only accommodates ships with a maximum draught of 14ft. Including the Welland Ship Canal between Lake Ontario and Lake Erie, ocean-going ships will be able to travel from ports on Lake Superior across the Atlantic if the project is completed successfully. On the whole the negotiations have been approved throughout the Dominion, but some objection to the scheme is held in Quebec, where it is thought that it is not sound policy to permit Americans to develop the St. Lawrence power project when Quebec has already power potentialities attractive to American industry and capital. At the same time the belief is expressed that the cost of the project is not justified and that the United States will wish to exercise some control over the river in exchange for financing the improvements.

Two British Liners to be Broken Up.

THE announcement is made that the liners "Demosthenes" and "Corinthic," which were built by Harland and Wolff, Ltd., twenty and twenty-nine years ago respectively, have been sold for breaking up in British yards. The "Demosthenes" is a ship of 11,223 gross tons, and was sailed by the Aberdeen Line of Geo. Thompson and Co., Ltd., in the London-Australian trade, but for some time past has been laid up in Rothesay Bay. It is understood that she has been bought for breaking up by the Hughes, Bolckow Shipbreaking Company, Ltd., of Blyth, for the sum of £9250. She was the first ocean-going liner to enter the King George V. Dock after the Royal opening, and did fine work throughout her years of service. The "Corinthic" has a measurement of 12,367 gross tons and is employed in the London-New Zealand joint service of the Shaw, Saville and Albion Company, Ltd., and the White Star Line. She arrived at Wellington, New Zealand, on September 23rd last and is scheduled to sail shortly for this country. The price at which she is to be sold on a three months' delivery is stated to be £10,250, which is comparable with that paid for the "Demosthenes," which is ready for immediate delivery. The sale of the "Corinthic" on similar terms to the "Demosthenes" for delivery three months ahead is in anticipation, so it is suggested, of a duty on imported steel being in force when the delivery of the ship is made, with a consequently better demand for home-produced scrap metal.

A Harbour Improvement Scheme.

THE Cornish fishing fraternity, which will be especially benefited, and the people of the county generally, have received with great satisfaction the intimation that the big breakwater and harbour improvement scheme at Padstow, which will provide employment for a large number of men for at least two years, has been finally approved by the authorities and will shortly be put in hand. The fate of the enterprise, upon which the Southern Railway Company is to expend a considerable amount of money, has for some time been hanging in the balance, but now that all the objections have been overcome, such as those raised by the Unemployment Grants Committee, to Sunday work and overtime, made necessary on account of tidal difficulties, the scheme will be proceeded with without further delay. An official statement received by Sir Donald Maclean from the solicitor to the Southern Railway Company states that "the company's engineer is now proceeding with the letting of the contract, and you may rest assured that he will act with all possible expedition." The actual work of construction, it is understood, will be begun very shortly. Padstow is the principal fishing port on the north coast of Cornwall, and, provided with an improved harbour, is likely to become a still more important centre.

Thames Flood Control.

AT a meeting of the Thames Conservancy Board, held on Monday last, October 12th, over which, in the unavoidable absence of Lord Desborough, Mr. C. G. Field presided, it was reported that the works at Teddington Weir were proceeding very satisfactorily and that very shortly the weir would be capable of discharging a flow practically double that of its former capacity, namely, up to 7,500,000,000 gallons per day. It was hoped that the weir would be able to deal with any possible flow of water. Mr. G. J. Griffiths, the Chief Engineer, stated that in the previous twenty-four hours the flow of the river had gone down to 900,000,000 gallons, which was normal for the time of the year. That was the first occasion during the summer that the flow was about the average. The heavy rainfalls of the six months prior to September had only been exceeded in the summers of 1903, 1924, and 1927, while the fall for August was the highest recorded for forty-nine years. The maximum daily natural flow was 3,692,000,000 gallons, as against the standard daily average for August of 605,000,000 gallons. Some of the springs in the Cotswolds were at the end of September actually higher than in the spring time, which was quite abnormal. With regard to the widening, deepening, and straightening of the river between Teddington and Hampton Court, the work had, he said, proceeded satisfactorily, and a considerable improvement had been made. Some of the Conservators had felt anxious as to the effect of the works on the amenities of the river, but the general impression seemed to be that there had been no adverse effect.

Through Railway Carriage Conference.

SPEAKING at a banquet held at the Guildhall last Tuesday, October 13th, in connection with the European Time-Table and Through Carriage Conference, Mr. G. M. Gillett, Parliamentary Secretary to the Ministry of Transport, said that the statutes of the conference defined its aims, which were to decide general questions relating to international communications by rail and waterways according to the requirements of passenger traffic, and to endeavour to ameliorate Customs service and passport verification at frontier stations. The Conference was fifty-nine years old, and since 1872 it had been pursuing its difficult and intricate task of co-ordinating time-tables. Those time-tables dealt sometimes with trains which travelled distances of 1000 miles or even more, across a number of frontiers, and connected in the course of their journey with many other important services. That valuable work did not come much into the eye of the travelling public. Nevertheless, it was an excellent example of the kind of systematic international co-operation to which we must look for a solution of so many of the difficulties of the post-war world. One of the many problems that had to be faced arose from the general demand to-day for increasingly rapid transport. Technically, considerable acceleration might be possible where the lay-out of lines permitted, but it must necessarily involve overhauling of time-tables, among many other considerations. That process of acceleration in the widest sense was likely to continue, and to produce a higher general average speed. In Great Britain the matter was receiving constant and successful attention from all our railways.

New Jugoslavian Flotilla Leader Launched.

ON Monday last, October 12th, the new flotilla leader "Dubrovnik," which is being constructed at the Scotstoun Yard of Yarrow and Co., Ltd., for the Royal Jugoslavia Government, was successfully launched, the naming ceremony being performed by Princess Olga of Jugoslavia, who was accompanied by her husband, Prince Paul. The principal particulars of the vessel were given in a Journal note of November 7th last. It may be recalled that the "Dubrovnik" has a length of 371ft. 6in. and a speed of 37 knots on a displacement of about 2400 tons. The twin-screw arrangement of geared turbines taking superheated steam from three Yarrow water-tube boilers of the latest design, has a designed output of approximately 42,000 S.H.P. Speaking at the luncheon following the launch, Mr. Harold Yarrow referred to the very friendly relations which existed between Great Britain and Jugoslavia, and the confidence which that country placed in the excellence of British design and workmanship. In the case of his own firm, the relations with Jugoslavia were particularly close on account of the interest the firm had taken in a shipbuilding yard at Kraljevica, on the Dalmatian Coast. Both shipbuilding and ship-repairing work was being undertaken at that yard at the present time, and, owing to the high standard of workmanship which was available in all the trades, the work carried out there was of first quality. Mr. W. W. Marriner, referring to the presence of Admiral Wickerhauser, said that his own firm had also a grand old man, Sir Alfred Yarrow. It was some seventy years since Sir Alfred had launched the firm, and probably that was why he was absent from that day's ceremony.

Marine Propelling Machinery Efficiencies.

THE presidential address of Mr. Archibald Gilchrist to the Institution of Engineers and Shipbuilders in Scotland, which was delivered on Tuesday evening, October 13th, appropriately dealt with the efficiencies which are attained in practice with the many forms of propelling machinery now in service. Recalling the recent statement of a shipowner that there was at present a bewildering choice of types, Mr. Gilchrist said that engineers had spent many a worried hour in pondering over the problem. Considering thermal losses, engineers had little cause for gratification, for, in the modern high-class steam-propelled cargo vessel, little more than 10 per cent. of the heat of the fuel was actually utilised in the effective propulsion of the ship. This fact Mr. Gilchrist illustrated in a heat balance diagram for a quadruple-expansion engine and exhaust turbine installation taking steam from Scotch boilers. A point often overlooked was that efficiencies tended to improve after service. In order to lessen the thermal losses, such auxiliary devices as feed heaters, regenerative condensers, with multi-stage feed heating with bled steam, had been used, along with higher steam temperatures and pressures. In connection with this section of the address, some interesting figures with regard to the efficiencies of cylindrical and water-tube boilers and the calorific values of coal and liquid fuel, ascertained from ships at sea, were given. Various types of marine oil engines and their efficiencies were compared and discussed. With regard to the reserve of power in ships, Mr. Gilchrist appealed for more collaboration with the object of reducing the high reserve of power for contingencies required by shipowners, which is often added to by the shipbuilder and results in the basis of power taken and the point of maximum efficiency being much too high. He suggested that the Admiralty practice of designing the machinery to be most efficient at a cruising speed would be a good one to follow for merchant vessels.

An International Container Competition.

IN a Journal note which was published in our issue of March 28th, 1930, we gave particulars of a prize competition for the most efficient designs for containers suitable for the transport of goods by sea, rail, and road, which was arranged by the International Chamber of Commerce, the League of Nations, the International Railway Union, and other bodies. The first part of the competition called for the submission of plans to the International Chamber of Commerce by September last year, when selected designs were chosen by the jury for construction and subsequent practical testing. The tests of these chosen designs, which included models by British, German, and Italian firms, took place only a few days ago at the Maritime Station at Venice, and the jury has now issued its award, premiums being given to the successful competitors on the points awarded. The tests included one for water-tightness and others for resistance to falling weights and to shock. The containers were tested by high-pressure water discharged from hoses, 12½-ton concrete weights were lowered upon them, and they were dropped from a height of about 18½in. when carrying an excess weight of 2½ tons. The fastenings were tested by projecting a railway truck with a loaded container against a buffer stop at a speed of about 6 miles per hour. It was shown that the containers were well adapted for the stowage with safety of the maximum amount of cargo into a ship's hold. It is now desired to standardise as far as possible the size of containers and the fastening and handling arrangements for international traffic. The knowledge which has been gained from the prize competition will, it is expected, enable the International Chamber of Commerce and the other bodies interested to complete, in collaboration with the manufacturers, the work they have undertaken.

The Late Sir James McKechnie.

IT is with regret that we have to record the death of Sir James McKechnie, at one time managing director of Vickers, Ltd., of Barrow-in-Furness, which took place in London on Monday last, October 12th. Sir James, who was in his eightieth year at the time of his death, received his early training on the Clyde. He was for several years with John Elder and Co. as principal draughtsman, and was also chief draughtsman and assistant manager at James and George Thomson's yard over a period of twelve years. His wide experience of marine engineering, both for mercantile and naval vessels, enabled him to take up a position as shipyard manager in Spain, where he spent some further time, after which he returned to this country. About the beginning of the century, he entered the service of Vickers, Ltd., as engineering director. Shortly after the outbreak of war, he was made the managing director of the Naval Construction Works at Barrow-in-Furness, with full charge of the engineering and administrative sides, where, under his direction, naval vessels, from battleships to submarines and all types of naval armament and projectiles, also airship construction, was carried out. Sir James was also responsible to the Ministry of Munitions for the erection and management of projectile and filling factories at Lancaster and Morecambe. He was a director of several other engineering companies allied to the Vickers concern. He retired from the position of managing director at Barrow in July, 1923, and since that time lived in New York and Florida. His death, which will be regretted by a wide circle of friends, took place in a nursing home in London, and he will be buried in Glasgow.

Press-Tool and Fixture Design.

By HENRY C. LANE.

No. IX.—MISCELLANEOUS TOOLS (*continued*).*

Section IV.—Short Length Chain Making.

There are numerous purposes for which a short length of chain is required. In long lengths all types of chain can be made automatically and purchased at low prices, and the manufacturer of short length chains has the option of cutting up the long chaining into the requisite short lengths, scrapping one link per length thereby, or of making the short lengths from the raw material by means other than automatic. In the case I am going to describe in this article, chains of the simple curled link type were required in four and five-link lengths, having a ring attached to the one end and a swivel to the other. Even if chaining was cut to the link lengths required, there still remained the question of attaching the solid ring to the one end, even though the swivel at the other end could be attached by utilising an open hook for the swivel bolt and closing the bolt through one link. Either the ring would have to be welded through the end link or the link uncurled sufficiently to allow of insertion of the ring, by which latter method there would be no necessity to scrap the dividing links in the chaining. On the other hand, the method most generally adopted was to make the chains by cutting and bending wire to a long U-shape, threading through ring or previous link, and winding each end of the U-shape to form a curl—the two curls being concentric—on a small hand-winding jig.

I cannot claim to be the originator of the principle outlined below, but I can definitely say that the originator was unable to carry the principle out

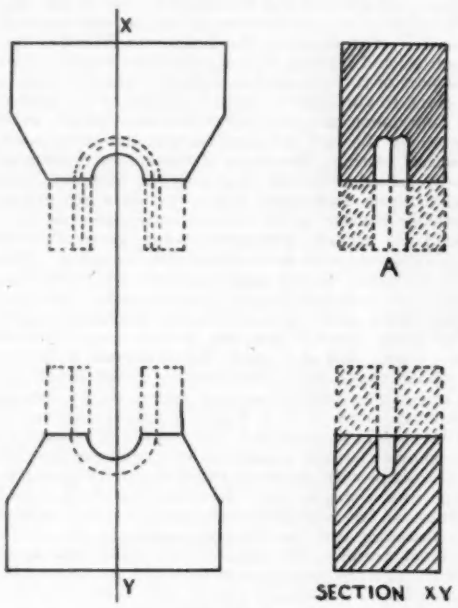


FIG. 64

successfully. Only one stage of the tools designed by him and made under his supervision gave anything approaching the required results. Briefly, the principle adopted is as follows :—Wire is wound direct from the coil on to an arbor running in a lathe. The arbor is such as, apart from the spring in the metal, will produce a flat coil, each complete turn of which is a link shape before curling—that is to say, an elongated straight-sided O-shape. Each complete turn of the wire was severed from the next turn by a chisel cut in the centre of one end of the shape, and thereby produced theoretically a straight sided U-shape with the two ends bent inwards on an initial radius for curling on the direct thrust radius curling principle. If the idea could be worked satisfactorily, it had one great advantage over the winding jig method in that a solid ring could be attached to either end of a link, whereas with the hand jig method, as the curls were wound around a centre arbor it was impracticable to attach a ring to the curled end of the finished link, and the swivel therefore definitely had to be attached by an open hook swivel bolt.

The first set of third stage, or curling, tools was made on a purely theoretical principle, as sketched in Fig. 64, front and end sectional views of punch and die. With these tools, however, the wire under pressure buckled in all directions, and punch and die were duly extended to give additional support to the wire, as shown by dotted lines in the same illustration. This was more satisfactory, but the tendency to buckle continued and the finished link jammed alternately in punch and die and necessitated an exceptionally long return stroke to ensure stripping from both, so that eventually the extension supports on punch and die were removed and a loose clamp was used to prevent the wire from buckling. This clamp was in the form of an open-ended spanner of suitable thickness and having a width between the jaws of a few thousandths under the theoretical overall width of the link. The wire rarely, if ever, tended to buckle inwards, unless some jam occurred in the curling and, similarly, buckles at right angles to the curling plane were very infrequent. Jamming in curling came after the three stages of manufacture had been in use for some time, and I was never able to trace the exact cause that allowed one link to curl perfectly and its apparently exact fellow to jam by its end or ends riding over the rib A in the punch

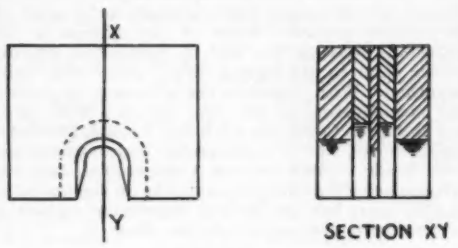


FIG. 65

and striking the opposing end. Numerous punches were made in an endeavour to overcome the trouble; each half was set wider apart and the rib extended to form a web, but the uneven heating for hardening and the uneven speed of quenching caused the web to break away in the very early stages. A web was definitely unnecessary and a composite punch was, therefore, built up as shown in Fig. 65. The radius groove in which the wire ran was eliminated as it was found that a flat groove gave equal results with less friction and a correspondingly lesser tendency to buckle the wire during the curling process. In the present curling tools punch and die are both built on this principle on account of the considerable saving

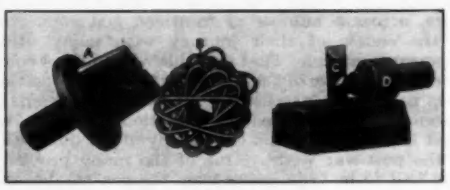


FIG. 66

in cost over the old type which had to be milled to the required groove shape.

Reference should now be made to the first stage arbor winding process, which is illustrated in Fig. 66, the arbor being shown at A and its product at B. It will be noted that the spring in the wire opens each link shape very considerably, and before these could be curled in the old tools they had to be squeezed or hammered together. In the actual winding process, the wire is led through an eye guide carried on the tool post of a lathe and through the slot in the end of the arbor. The lathe is pulled over by hand and the slide fed forward to bring the wire feed eye into line with the shoulder of the arbor, where the full-size links are formed. The shoulder of the arbor is chamfered to enable the links to be stripped by the pulling down of the new shape between arbor shoulder and previous link. The tail-stock of the lathe is removed and a channel of wood placed in position to carry the wound links as they leave the arbor. It is possible to wind a coil of links up to 4½ft. in length, but over this length the increase in weight that is being turned causes the links to open as they leave the arbor.

As the arbor revolves immediately after bending one end of a link, it puts in a bend in the side of the link in the form of a slight concave from one end to the other. When the arbor starts to bend the other end, this concave bend in the wire has been partially straightened out on the flat side of the arbor, and while the bend at the end is in progress the bending strain imposed causes the remainder of the concave bend to disappear and produces a slight convex bend in its place. This is one of the most definite causes for the tendency of the link to buckle outwards on being curled and the necessity of squeezing the ends of the link together to enter the curling punch only adds to this convex bend, since pressure to close the ends is almost naturally applied to the extreme ends where the leverage is greatest. To cut off each link the original design of tools was as shown in Fig. 66. A chisel edge punch D operates in opposition to a chisel edge punch C and gauging is carried out very erratically by eye. No matter how carefully the tools are set, they are extremely liable to throw out of true position and any attempt at gauging even by eye becomes absolutely useless as a result of error in position of punch and die. Obviously, it is more or less essential that very little variation should exist in the length of each side of a link as otherwise after curling, one curl would be finished when the other left a gap to be completed equal to twice the amount of the original error in gauging for cutting off the links. If one arm had been regularly a fixed length longer than the other, the curling die for that side could be slightly enlarged to absorb the extra length in a curl of slightly larger diameter. This was not possible and to overcome all the difficulties outlined the tools for all three stages were redesigned, the basic principle alone remaining the same.

Fig. 67 shows the first and second stage tools

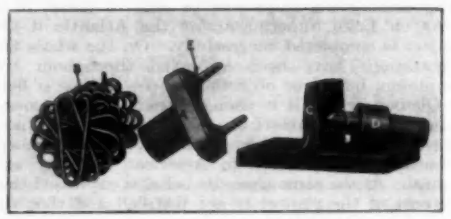


FIG. 67

and the product of the first stage A at B. The main features of the first stage product are identical with those produced on the old design of arbor, but the bend in the side of the links produced is slightly concave in place of the undesirable slightly convex bend produced with the old arbor. As will be seen, the arbor at A is composed of a bar of steel, on one side of which is mounted the shank for the chuck, the other side having two circular pegs of double cone section. The first cone is barely perceptible, being actually only a slight taper to allow of easy stripping of the formed wire, while the second cone takes the place of the chamfered shoulder of the old design of arbor. The wire feed eye is brought level with the junction of the two cones at E, and the amount of concavity of bend in the sides of the link is controlled by the distance of the eye from the lathe centre line. The closer the feed eye approaches the lathe centre line, the greater the concavity and *vice versâ*, though the reason for this can only be definitely conveyed by a practical demonstration. Unlike the old arbor, no traversing movement of the eye is necessary to start a coil of wire. The end of the wire, after being passed through the eye, goes between the two pegs and the lathe is pulled over by hand only sufficiently far to allow of guiding the free end of wire to that side of the feed wire farthest away from the lathe chuck. As soon as this has been attended to, the lathe can be put under power and run comfortably at 110 to 120 r.p.m. The lathe should be stopped before the coil reaches

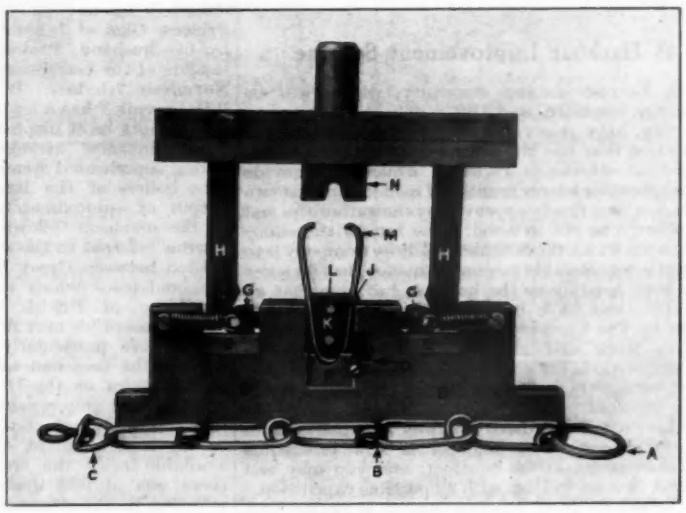


FIG. 68

4½ft. in length, and the coil severed as close to the arbor peg points as possible with a pair of wire cutters. This obviates the necessity of starting a free end of wire for each coil and the lathe can be put immediately under power.

The second stage tools are shown in the same illustration, and it will be seen that the punch D is exactly the same as used on the old second stage tools. The main feature about the new tools is that the die is so designed that as far as the die is concerned the link shape cannot be placed in the wrong position and cut. The die block is very carefully shaped to fit the end

* No. VIII. appeared October 9th.

of the link shape exactly, and if by chance the shape should be out of die centre by not being fully down on the die surface, the descending punch in forcing it down will definitely force it into position. Careful tool setting alone is required to produce a central cut, and once set, the tools do not tend to throw out of line, as in the old design, since the sole cutting edge is on the punch, the die being provided with a very slight flat at the top of the radius form. From these first two stages on the new design therefore is produced a link that meets all requirements, with the exception of the springing open of the sides of the link. The amount of the spring varies with different consignments of steel, and the final stage tools have to be capable of adjustment to allow for this difference in the natural strength of the metal used from time to time.

The present final stage curling tools are illustrated in Fig. 68, and detail of the curling punch is given in Fig. 65. Detail of the small slides and their operating punches are given in Fig. 69.

The finished chain is shown in Fig. 68 at B, with the ring attached at A and the swivel connected to the other end at C. The main die shoe D is cut from 1¼in. mild steel to the shape, as shown. Steel blocks are let in at E to give durable support to the heads of the small slides G. The punches H operate on rollers carried on the slides G, as will be seen in Fig. 69, and are supported by other rollers carried in the main die shoe, but not visible in the photograph. A slot in the die shoe is provided to carry the actual die F, which is kept in position by the small screw, shown at the edge of the die. The die shoe is cut away at O to allow for individual feeding requirements. In this particular case it allows for the swivel loop being slipped over the plain link M and carried down and right away from all moving parts of the tools. The plate K carries the stripping peg J, which can, if required, be inserted in the higher hole L. It will be noted that the punch N grips the curled link and the peg is required to strip the link therefrom. The reason for the extension on the punch N will be apparent later. In the meantime, to complete the description of the design, the front view of the left-hand punch H and plan and front view of the left-hand slide G, shown in Fig. 69, should be carefully

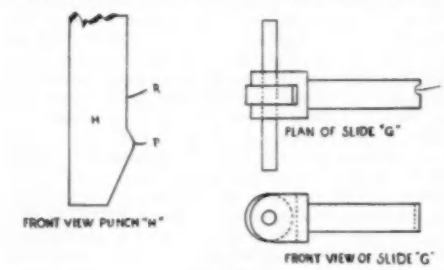


FIG. 69

considered. It will be seen that the angle drive of the punch H runs to a peak at P and back to the parallel face R. This will give an oscillating motion to the slide G, and the oscillation is completed before the actual curling of the link is commenced. The same oscillation of the slide takes place when the punch rises, and it is the latter stroke for which the oscillation is required. The slide G has a groove in its end face at S, the groove on the left-hand roller being offset towards the back of the tools and that on the right being offset to the front of the tools. The groove in the die F is cut at an angle to bring the two sides of the link when upright into register with these two grooves in the slides.

In operation, the plain link is threaded through the curl of the previous link or through the swivel loop and placed in position in the groove in the die F. The slides G actuated by the punches H grip the wire in their grooves S and force the two arms of the link together past the true parallel, when the points P of the punches ride over the slide rollers. These peak points are designed so that when the link is in the die, the softest material used will not take a squeeze bend and remain past the parallel. When the parallel faces R of the punches are in operation, the measurement between the working faces of the grooves of the slides is a fraction under the outside diameter of the curls of the finished link, consequently the slides will lightly hold the link after curling at whatever height the stripping peg J strips the link from the punch unless the link, when stripped, has risen above the slides. As soon as the parallel faces R of the punches reach the rollers of the slides, curling of the link commences in the composite punch N. The punch rises and carries the curled link with it to be stripped by the peg J. The position of this peg is determined—by experiment, if necessary—by the amount of squeeze required to bring the two sides of the link parallel in the finished state. If the material is the softest used, the peg will be placed in the hole L, as the initial oscillation of the slides has already forced the link sides parallel. If, on the other hand, the wire is particularly stiff it will be necessary to locate the peg so that the centre of the radius at the bottom of the link is only very slightly below the slides, the position of the peg dropping towards the die as the material used becomes softer. When stripped, the link is held by the slides as before described, and the oscillation on the final portion of the up stroke of the press will, if the peg J is placed correctly, squeeze the link to give a finished parallel shape.

In assembling the ring to the last link of the chain, the procedure is exactly the same, except that the last link is threaded through the previous link and also through the ring, the former being allowed to fall to the surface of the die F, the latter being held above the slides G until curling commences, when it is lifted as high as possible into the curling punch and the wire curls around it.

At first sight, these final stage tools may appear far more complicated than necessary, and it was to show the need of this apparent complication that I fully described the previous unsatisfactory designs of the various stages. Incidentally, the old tools are not to the original design as handed to me, but incorporated rather makeshift methods of rendering the basic principle capable of operation when the original designs were not capable of such operation.

(To be continued.)

The British Association Centenary Meeting.

No. IV. *(conclusion).**

SECTION G. *(continued).*

WHEN the proceedings were resumed on Tuesday morning, September 29th, Sir Thomas Hudson Beare occupied the chair.

THE GAS INDUSTRY.

The first paper dealt with was one on "The New Gas Industry," by Sir David Milne-Watson. In it the author, after surveying the history of the industry from its start in 1812 and incidentally referring to the part played by Michael Faraday in its activities, said that, because of its age, popular opinion inclined at times to the view that the gas industry was old fashioned, out of date and on the decline; in effect, that it was unscientific and might be superseded without loss to the well-being of the nation. The action of successive Governments in agreeing to an expenditure which would exceed £50,000,000 in order to bring electricity supply undertakings up to date, had encouraged the impression that gas would one day be superseded; but nothing could be further from the fact. In 1929, the latest year for which figures were available, the industry treated 18,609,448 tons of coal, and for carburetted water gas used 949,235 tons of coke and 233,349 tons of oil. In the same period it supplied 299,499,000,000 cubic feet of gas, 8,015,437 tons of coke, 223,500,000 gallons of tar and tar products, and 161,743 tons of sulphate of ammonia. There were nine and a-half million consumers. The energy sold to the public in the form of gas was over five times that sold in the form of electricity. The throughput per retort had been increased from 2 tons a day in early installations to 10 tons a day at the present time, whilst the capacity of single individual plants had been raised to over 1000 tons a day. The Gas Light and Coke Company was at present installing at the Beckton works—the largest works of its kind in the world—a coke oven plant capable of carbonising 1200 tons of coal a day and had arranged for its extension to 5000 tons a day. That plant was, in accordance with the practice now coming into vogue in modern carbonising plants, being provided with coal blending and mixing equipment designed to produce domestic and industrial coke of the highest quality.

In carburetted water gas production development had proceeded on the lines of complete automatic working, which included the elimination of hard clinkering, formerly one of the most arduous operations in a gasworks. The use of the heat of the spent heating gases in waste heat boilers and its subsequent conversion to cheap power, commenced with that section of the plant, but had now been extended to the carbonising plants. The application of modern chemical engineering principles in gasworks had led to considerable improvements in the apparently simple and established methods of removing tar, ammonia and other impurities from the gas. Contamination of tar by ammonia salts, and of ammonia by the phenolic constituents of the tar, had been avoided by tar removal above the dew point of the gases. Electrostatic precipitation of the tar by high-voltage unidirectional current had been found to be of considerable value for that purpose. The encouragement given to home-produced oils had stimulated the recovery of benzol from gas, the process being either incorporated with naphthalene recovery, by oil washing of the gas, or, as in several recent instances, activated carbon was used as an absorption reagent.

Engineering developments had kept pace with those on the chemical side. Handling plants for coal and coke, large-capacity storage bunkers, and purifier vessels in reinforced concrete had all been devised to meet the special conditions of the day. Finally, it was mentioned that gas appliances for consumers had been largely improved in efficiency, reliability, and utility as a result of continuous research work into the principle of working and design of Bunsen burners and into the nature of combustion.

Dr. C. H. Lander, opening the discussion, expressed the pleasure it gave him to confirm the assertions made by Sir David. The history of the industry might be dealt with from many standpoints; but, in truth, it was nothing but a story of progress against, and in spite of, statutory handicaps. Those handicaps still existed, even though their vexatious nature and unfairness had been emphasised again and again. One of the latest developments of the industry was the utilisation of coke oven gas in gasworks and the association of the two types of gas in the provision of supplies for a grid system of distribution. That system had been decided upon for a trial scheme in and around Sheffield.

Mr. A. E. L. Chorlton, referring to the distribution of gas through a grid system, said it was strange that the scheme had not been utilised to a greater extent. It seemed peculiar that the gas industry had acted with such timidity in dealing with that proposal. It was customary with the electrical people to adopt the view that any suggestion of such a character could be successfully carried out and they entered into the scheme with confidence and co-operation.

Professor Fortescue spoke of the unfortunate atmosphere aroused in regard to supposed competition between gas and electricity. There was no real competition between gas and electricity; they were really complementary to each other. For internal lighting gas could not compete with electricity, but the position was quite different in regard to outside illumination. He looked forward to the time when closer co-operation would be possible between the electrical and gas industries with a mutual recognition of the merits of the two systems of energy, so that the industries would be firmly placed on the basis of real service, and not upon any suspected antagonism.

Sir Thomas Hudson Beare, in closing the discussion, said that in his own house he found use for solid fuel, electricity, and gas. When a fire had to be kept on for sixteen or seventeen hours, he used solid fuel as the cheapest medium. Should the heat requirements extend to only an hour or so, he used gas fires. When the heat was required only for a few minutes, then it was a great convenience to be able to plug in an electrical heater. All systems of heating were capable of successful service, if used intelligently. He was quite sure there were equally big opportunities for the gas and electricity supply undertakings.

Sir David Milne-Watson, replying to the discussion, said that the provision of a gas grid system was not quite so simple a proposition as it might appear to be. The electrical undertakings were only supplying current, but gas concerns also supplied by-products, and especially coke. One great disadvantage of the gas grid system was that it was essential, for the economic welfare of the industry, that the coke produced should find a sale, and the position of that market must be considered in dealing with the location of the gasworks. It might be suggested that a gasworks should be built on the Kent coalfields, and have pipe lines to carry the gas to London. That would mean the installation of enormous lengths of mains of large diameter, and instead of the coal being brought to London an almost similar bulk of coke would have to be carried, and the railway charges would be as much for carrying the coke as for carrying the coal. Where, then, was the economic advantage? The general adoption of a gas grid system, therefore, was quite a different proposition from that of an electrical grid. The gas industry missed a great opportunity in its early days by not undertaking, with gas supply, the duties of electricity supply as had been done in America. It was difficult now, however, to get the two industries together, although they could be worked together. He himself had always advocated and worked for co-operation between the two industries.

FORCE AND SHRINKAGE FITS.

Professor E. G. Coker then submitted a paper on "Force Fits and Shrinkage Fits." In his opening remarks he referred to the number of important cases of engineering structures in which two parts were associated by the forcing of the one into a hole in the other, which was of slightly less diameter. Slides were used to depict the process of building up large and small crank shafts. In such cases of engineering practice, the stress distributions in the assembled parts were usually difficult, if not impossible, to solve by analysis. The author then showed how their character could be estimated by the use of the stress lines shown in celluloid structures, when submitted to polarised light. The examples dealt with consisted of crank webs, locomotive wheels, boiler tube plates and the like. A number of such cases were described in some detail and the application to actual practice of the measured stress distributions was discussed, in connection with the theory of stress distributions in multiple connected plates.

Sir Henry Fowler, opening the discussion, said he would have liked to have seen similar presentations of the case when running stresses were added to those put initially into the structure by the process of building up. The forces used in this country for force fits were limited to 10 tons for each inch of diameter of the pin. In America there was a demand for the raising of this value to 15 tons, and in some cases for a further addition, bringing it up to 25 tons per inch of diameter. He anticipated, however, that trouble

* No. III. appeared October 9th.

might be experienced should such pressures become general.

Mr. J. S. Wilson said that what they really wanted to know was the extent to which the stresses disclosed by photo-elastic examination affected the working life of the built-up structure. The stress shown in those structures might appear to be alarming. Effect of finish and lubrication might effect the distribution of stress, and change it entirely from the values found in the determinations carried out by photo-elastic examination of material, in which such matters were not dealt with.

Professor Coker, in reply, said he had not yet gone far enough to be able to determine the effects of the additions of running stresses to those due to the form of construction nor to investigate the effects produced by the existence of oil films.

Professor C. F. Jenkin followed with a description of the work he has been carrying out on "Earth Pressure Investigations," and illustrated it with demonstrations of model apparatus. He said there were four separate cases of earth pressure which had to be studied to obtain a complete knowledge of the subject. These were the two cases of sand pressing against a wall and sand main foundations, and the two similar actions with clay. So far investigations had been limited to the single example of sand pressing against a wall. They were conducted with a small wall in the model, which could be moved upon a horizontal plane or tilted while sand was pressing against it. The first thing necessary to obtain a clear understanding of earth pressure effects was to observe the action of small balls enclosed in such a way as to represent one single plane in the sand load. The lecturer had such an arrangement with the balls enclosed between glass plates with a section of the wall, against which they pressed, and demonstrated the effects by means of a lantern. At the beginning, all the balls were touching their neighbours. Immediately a movement of the wall was made, a plane of rupture developed in the system of balls, which was markedly shown. The effects of tilting the wall were also demonstrated.

The movement of the sand pressing against a wall, as the latter was given horizontal movement, or tilting, was also shown with a model on the lecture table. In that case observation was made possible by means of a glass panel in the wall and a coloured layer in the sand afforded the means of demonstration of the movement of the sand. Provision was made in the apparatus for the actual measurement of the forces acting upon the wall. It was found that as movement continued, the results were not exactly the same. They varied step by step, but after a certain travel the same conditions as at the start were reached, and repeated the same cycle on further movement. Actually, the angle of repose was shown to vary between 30 deg. and 35 deg. The static friction angle was greater than the moving friction angle. That might be due to the fact that when the sand was stationary the grains were interlocked, but once movement was started rolling conditions were established, and when the maximum amount of rolling occurred the minimum frictional angle was found.

The experiments seemed to indicate that the Rankine theory of earth pressure actions was faulty. Assumptions made in the text-books had never been found to apply in any of the experiments so far conducted. The principle enunciated by Osborne Reynolds seemed, however, to be quite accurate. A remarkable feature of the work was that the height of the centre of pressure on a wall with sand pressing against it was shown to be not one-third way up the wall, but was much higher, and even attained twice that height. In closing his demonstration, the lecturer emphasised that the work so far done only applied to the pressure of sand against a wall, and thus represented but one-quarter of the whole problem.

When the meetings were resumed on Wednesday, September 30th, Sir Alfred Ewing occupied the chair. The first business was the consideration of a paper on "Spark Neglecting Commutation: A New Principle in Large Power Direct-current Production," by Professor Julius Hartmann.

In the first part of this paper the principles of what the author described as spark-neglecting commutation, but which might be classified as mercury jet commutation, were compared with those of the mercury vapour rectifier. The equipment necessary for the jet system was described. The moving member of the commutator was a wave-shaped mercury jet. The wave moved with a certain velocity connecting an electrode, in its path, alternately to two main electrodes below. The wave was actually produced electro-magnetically, by the interaction of a constant magnetic field and an alternating current passing through the jet. This current originated from the same source as the voltage that had to be commutated. In that way synchronism was ensured between that voltage and the motion of the wave. Commutation at the proper moment, in the period of the voltage, was secured by adjustment of the distance of the main electrode from the field. A wearless commutator was an essential need for spark-neglecting commutation. Equally important, however, were the means for absorbing the electro-kinetic energies set-free during the commutation, in the time available for absorption. It seemed that only hydrogen could do that in the case of large-power commutation. It was known that the hydrogen molecules were dissociated into atoms in an electric arc, with the absorption of a relatively large amount of energy. The commutation spark was actually a transient arc, and it was therefore to be expected that hydrogen was dissociated in that, too, in which case the large dissociation energy would account for the rapid absorption of the spark energy. It was further known that if the dissociated hydrogen atoms met a cold wall they again united to form molecules, setting free the energy that was absorbed during the dissociation. While the largest voltage difference between adjacent bars of the collector in a direct-current generator was of the order of 30 to 50 volts, the corresponding voltage difference between the two sides of a jet wave commutator, operated in hydrogen, could at least be raised to 1800 volts.

The spark-neglecting commutators and rectifiers were able to deal with comparatively great powers at very high voltages, and that, in association with the fact that such rectifiers were reversible in operation, seemed to make the principle of spark-neglecting commutation a suitable means for a future system of high-tension direct-current transmission.

Professor Miles Walker, in opening the discussion, said that the system of commutation described had the attractive characteristic that it could be used for the conversion of D.C. to A.C. There were so many advantages in long-distance transmission by D.C. over A.C., that the problem connected with such a scheme must be solved eventually. The transverter system was certainly not a failure, but the proposal had failed to convince practising engineers. The mercury vapour rectifier could be used in connection with a rotary machine to act as a spark eliminator, and make a motor with a supply at 100,000 volts run absolutely sparklessly. In the future D.C. transmission would be used over long distances, with local conversion to A.C. with rotary machines and the installation of mercury vapour rectifiers as the means of spark prevention.

Professor W. Cramp said that when the grid system of distribution was first proposed, he suggested that it might not be many years before D.C. transmission would supersede A.C. transmission. With the mercury arc rectifier, successful work was possible in practice up to 10,000 volts, and in the laboratory to 100,000 volts.

Sir Alfred Ewing asked what pressure was used for the hydrogen atmosphere and also whether it was necessary to introduce any system of cooling?

Professor Hartmann, in reply, said that spark arresting by the mercury jet wave commutator could be effected economically, but not with very small plants. He thought there was no limit to the magnitude of the voltage to be dealt with by spark-neglecting commutation, by combinations of sets of equipments. The idea of the dissociation of the hydrogen giving the solution of what happened within such an atmosphere, was not new. The same effect was found in electric arc welding with a hydrogen atmosphere at the arc. He had conducted experiments on the commutator with hydrogen pressures up to 20 atmospheres. There was no necessity for any cooling system with the plant.

Reports.

Professor G. W. Osborne Howe then presented the interim report of the Committee on Electrical Terms and Definitions. It showed that, during the past year, six members of the Committee had written and circulated theses dealing with different aspects of the questions under consideration. The difficulties and differences of opinion were being considered and debated in many other countries, and by the International Electrotechnical Commission, but all were finding it hard to arrive at an agreed system of definition. The difficulties, however, were largely due to the different methods by which the subject was approached and treated by physicists and electrical engineers. Attempts to obtain agreement immediately disclosed disagreements of a fundamental nature, on which it was essential to obtain understandings before anything further could be done. The Committee was reappointed with the addition of Sir Richard Glazebrook, Dr. W. E. Sumpner and Dr. D. W. Dye.

The report of the Committee on Stresses in Over-strained Materials, consisted of five separate papers, which were introduced by their individual authors.

Sir Henry Fowler presented the first. It dealt with "The Hardness of a Steel Tube Along Certain 'Lüders' or 'Piobert' Lines." The author stated that some years ago his attention was called to corrosion of certain tubes in locomotive boilers, taking place along lines diagonal to the axis. No explanation could then be offered, but, shortly afterwards, he noted certain stock tubes rusting in a manner which at once suggested the presence of "Lüders" lines. The rusting had only taken place where the mill scale had cracked. Investigation showed that this cracking of the scale on a locomotive boiler tube could be reproduced in a carefully made tensile test. The tests showed definite differences in hardness at the lines and in the intermediate material. Specimens tested in 1921, however, had been recently re-tested and showed no marked differences on and off the lines. Some action of an ageing character was suggested as the possible cause of the change.

Sir Henry Fowler also presented a contribution on "Indentation Hardness of Test Pieces Resulting from Plastic Flow." The experiments referred to clearly showed that plastic flow had progressively hardened the material. It was of considerable interest to note that that took place at points on the bar where the material had apparently not been stressed up to normal yield point Further experiments were in contemplation with the object of more thoroughly investigating the mechanism of break-down at one yield point.

Professor G. Cook then dealt with his paper on "The Upper and Lower Yield Points in Steel Exposed to Non-uniform Distributions of Stress." The load extension diagrams of annealed or normalised mild steel tested in tension, he said, were peculiar, in the sudden fall of the load which took place at the yield point. When the means of application and measurement of the load were such that at all instants the stress in the specimen was balanced, it was seen that the load required to continue the extension beyond the yield point was approximately constant, at a value which might be as much as 30 per cent. below the limited yield stress, and continued over a range of extension of the order of ten times the total elastic extension up to the yield point. The investigation covered the determination of whether that action was peculiar to a tensile test or if it occurred when materials were over-strained in torsion and flexure, and in thick-walled cylinders exposed to internal pressure. The results obtained showed that the agreement between the lower yield stress values was sufficiently close to be consistent with a constant value of the lower yield shear stress, under all conditions, and it indicated that the process of yielding, observed in tension, was followed fairly closely in the non-uniform distributions.

Professor B. P. Haigh presented a contribution on "Plastic Strain in Relation to Fatigue in Mild Steel." It dealt with work on the relationships between the upper and lower yield points and the fatigue limit in mild steel. It was found that in tests under cyclic loads, the phenomena of primary and subsequent yield occurred in nearly the same manner as under steady loads that were gradually increased. Hysteretic heating raised the temperature of the test pieces subjected to rapid cyclic stresses and probably affected the values of the yield points, even in brief tests, when the range of stress was great. Experiments further showed that the limiting ranges of nominal stress required to cause fatigue fracture in mild steel test pieces pierced with small holes were nearly independent of the value of the nominal steady component stress up to 6 tons per square inch, and were approximately one-half the limited value for unpierced test pieces.

Messrs. J. G. Doherty and F. W. Thorne gave a paper on "The Phenomenon of Tensile Yield in Mild Steel and Iron." The majority of the tests quoted showed that the stress and strain were almost perfectly proportional up to the higher yield point. The stress at the higher yield point was from 10 per cent. to 50 per cent. higher than that at the lower yield point. The specimens used in tests were highly polished, so that the slightest disturbance of the surface could be detected. There were different types of markings produced. At stresses below the yield point, the surface became slightly, but uniformly, mottled. When the higher yield point was reached large "Lüders" lines suddenly appeared across the smallest section of the specimens.

Mr. J. S. Wilson opened the discussion, with the expression of the view that engineers were only now getting to understand the properties of materials, and gaining confidence in their action in service. He called attention to cases where, in the course of unsuitable treatment in the works, initial stresses were put into the metals to be used.

Sir Alfred Ewing, F.R.S., has been elected President of the Association for next year.

Motor Car Show at Olympia.

No. I.

The twenty-fifth annual exhibition organised by the Society of Motor Manufacturers and Traders, Ltd., is being held at Olympia from October 15th to 24th, and it says much for the vitality of this great industry that the number of firms represented shows little reduction compared with last year. While it is true that several of the less important manufacturers have dropped out, owing to stress of circumstances, the larger companies appear to show no sign of relaxing their energies in spite of the unparalleled depression in all the leading industries of the world. Sir William Morris has even predicted a record year for 1932. Economy being the watchword of the times, it is not a matter for surprise that motor car manufacturers have devoted their chief attention only to improving the details of their existing models, especially in the direction of increased body space, better fittings, and a wider use of special alloys which combine reduction of weight with a higher degree of finish. If prices have not been lowered perceptibly, better value is being offered, and it may be that some of the present prices will undergo an increase before long.

As regards body design, the convertible saloon tourer with sliding roof will prove to be the most popular. Improvements in the methods and plant for manufacturing all-metal bodies have enabled some makers to dispense with pillars and other obstructive features. Safety glass, like collision bumpers, has for some time past been a standard equipment with most makers, although in some of the cheaper cars safety glass will be found only in front screens. There are signs of a revival of the two-piece separately adjustable form of front screen, while the foot-brake controlled rear red warning light will be found on more cars than in the past.

As regards chassis lay-outs, the changes in next year's models will be confined chiefly to details, such as improved methods of lubrication of the wearing parts. The use of insulating pads of rubber between the chassis frame and certain components and in relation to some of the fittings, will tend to produce a greater degree of silence than has hitherto prevailed. Gear ratios have in some cars been re-arranged, and further flexibility is being achieved by the provision of four gears, including a "silent third." The free wheel incorporated with the gear-box is confined chiefly to imported cars. Wire wheels are deservedly coming into greater favour, with large boss type hubs to give access to the bolts. Hydraulic four-wheel braking systems will be seen to be increasing in favour.

Revolutionary departures in engine design and construction are conspicuous only by their absence. The principal improvements will be found in connection with pistons for which new alloys containing magnesium are being used by some makers. Great developments have been brought about in recent years in the design of cylinder heads, gas manifolds and ports, whereby improved combustion and sweeter running are effected. These are features which are not visible to the casual observer, but their importance cannot be over-emphasised. Other unseen improvements in connection with the power unit which tend to give a longer life to the working parts are replaceable oil filters and air cleaners.

The most noticeable change in the outward appearance of the standard makes of cars will be in connection with the radiators, which will be found of pleasing and symmetrical appearance, while automatic thermostats or temperature regulators of the pivotal slat type are being more generally fitted. The tendency which has prevailed during recent years to replace the magneto by battery and coil ignition devices is emphasised in the new cars to be seen at Olympia. For six-cylinder engines in particular this change will be distinctly for the better. Magnetos for this type of engine have not proved an unqualified success.

The section of the Exhibition devoted to garage and service equipment will be found to have grown considerably since the last Show. It should prove of great interest to users of motor cars. Here are being shown the most up-to-date methods employed in service stations for such operations as washing, oiling, decarbonising, brake testing, &c. The modern power-driven washing machine is a boon to the owner-driver, and this remark applies with equal force to an ingenious appliance whereby the driver can see at a glance the condition of his road wheels for alignment, and the brakes as regards equality of power.

Wolseley.

A new model is being introduced by the Wolseley Company in the shape of an inexpensive six-cylinder four-door saloon, in which a large body space relative to the length of the chassis is achieved. Views of this car, part of the engine and the gear-box, are given in Figs. 1 and 2 and Fig. 6, page 410. The power unit has cylinders of 57 mm. bore by 83 mm. stroke, overhead valves and a cam shaft driven by roller chains in two stages. Full pressure feed lubrication and an air cleaner and fume extractor are features of interest. The clutch is of the single plate fabric-lined type. The four doors are fitted with winding windows, there is a sliding sunshine roof, and the upholstery is pneumatic. The car has a four-speed gear-box with silent third, and the petrol tank is at the rear. The deep radiator is fitted with a stone guard, and the wire wheels are of the "Magna" type. Lockheed hydraulic brakes, hydraulic shock absorbers, Triplex glass screen, 12-volt electrical equipment and chromium finish are other items in a remarkably full specification. Another exhibit by this firm is the 16–60 horse-power "Viper" car, which is now being fitted with a four-speed gear-box with a silent third gear. The "Viper" engine has six cylinders, 65 mm. bore by 101 mm. stroke, the tax being £16. A still more powerful car is the 21–60 horse-power with six cylinders, 75 mm. bore by 101 mm. stroke and a £21 tax.

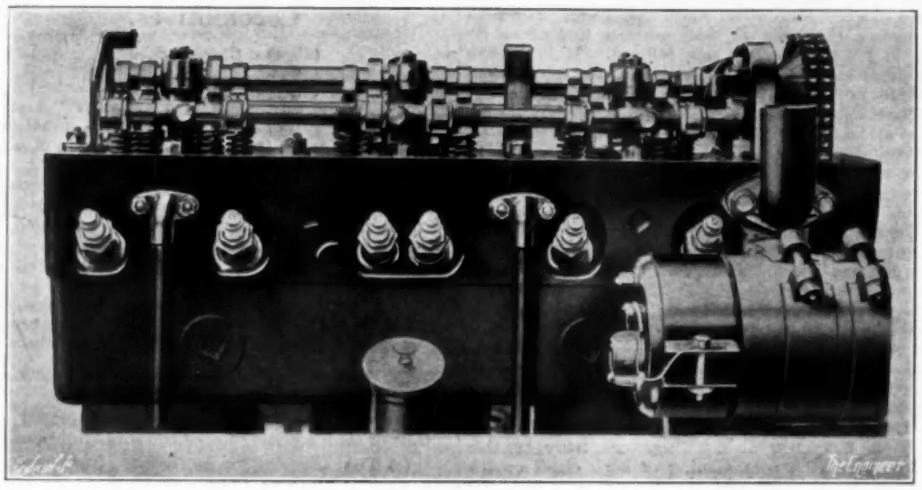


Fig. 1—Six-Cylinder Engine—Wolseley

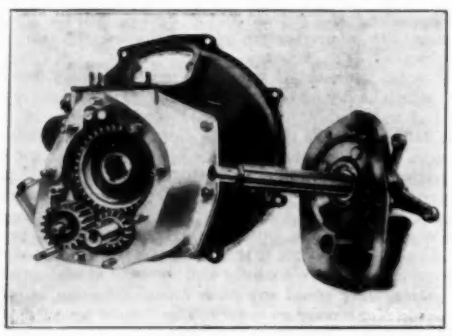


Fig. 2—Four-Speed Gear Box—Wolseley

Morris.

There is an ample range of cars in the exhibits of Morris Motors, Ltd., including the Morris Minor, the Morris "Family Eight," the Morris Cowley, the Morris "Major Six," the Morris Oxford Six, and the Isis Six, ranging in price from £100 to £350. On all, except the lowest-priced car, wire wheels are fitted, and there is a new chromium-plated radiator with automatic shutters. The newcomer is the "Family Eight" saloon—Fig. 7, page 410. This car has a four-cylinder engine with a bore of 57 mm. and stroke of 83 mm., giving a cubic capacity of 847 c.c., and is taxed at £8. The engine is a unit construction with a totally enclosed clutch, and three-speed gear-box. The power unit is carried by a four-point attachment on a downswept frame supported at the front and rear on long semi-elliptic springs. The rear axle is of the three-quarter floating type, with spiral bevel final reduction and the transmission from gear-box to back axle is by a large-diameter tubular propeller shaft and fabric universal joints. Ignition is by means of battery and coil. The foot brake operates internal expanding shoes in 9in. pressed drums on all four wheels by the Lockheed hydraulic system. This car affords ample seating accommodation for four fully-grown persons. It has a sliding roof which is easily operated and weatherproof.

The Morris "Isis Six"—Fig. 8, page 410—has a six-cylinder engine with a bore of 69 mm. and stroke of 110 mm., giving a capacity of 2468 c.c. and a Treasury rating of 17·7 horse-power. It has overhead valves, a totally enclosed multi-plate clutch, and four-speed twin-top gear-box built in unit construction. The six-throw crank shaft is carried on four bearings of ample dimensions, and is machined all over. Ignition is by battery and coil. An overhead cam shaft of large diameter, supported in three generous bearings, operates inclined valves through a light, but strong, rocker mechanism. The combustion chambers are machined all over, which ensures complete uniformity of compression, sweetness of running, and the minimum of carbon deposit. The cam shaft is driven by a Duplex roller chain, automatically tensioned by a device which restricts backlash and facilitates dismantling. The cam shaft chain, in addition, drives two auxiliary shafts, from which are driven the oil pump, distributor, dynamo, water impeller and fan. Special provision has been made in the detachable head to permit of its removal for decarbonising without disturbing the timing or necessitating the removal of the chain or even its readjustment. The steel connecting-rods, of "I" section, machined all over and individually and collectively balanced, further ensure sweetness of action, while the big-end bearings are of the full-ring type with white metal linings in heavy bronze shells. The pistons are of aluminium with three narrow rings, the lower one being of the oil seal pattern. The reciprocating assemblies are balanced as units to within 0·2 oz. Full forced feed lubrication is provided by a pump of the spur gear type, mounted externally and carried well below the oil level, so that it is self-priming. Oil is fed under full pressure to all important bearings, and oil cleanliness is assured by a large tray pattern filter. The brakes are of the hydraulic type, and operate in drums 14in. in diameter.

Austin.

One of the most popular small six-cylinder cars is the Austin "Twelve-Six," Figs. 3 and 5 and Fig. 9, page 410, which was designed specially for the owner-driver. Although designated 12 horse-power by the makers, this engine has an R.A.C. rating of 13·956 horse-power, and the brake horse-power developed at 2400 revolutions per minute is 24. The bore and stroke are 61·25 mm. and 84·63 mm., and the chassis weight 11 cwt. 3 qr. The cylinders are cast monobloc and the pistons are of aluminium alloy, while all the valves are on one side, the induction and exhaust manifold being mounted to provide a hot spot. The lubrication of the engine is effected by a gear pump, and the ignition by means of a battery and coil with a distributor accessibly mounted. This distributor incorporates an automatic advance and retard mechanism. The clutch is of the single-plate type, and the gear-box forms one unit with the engine. There are three gear ratios of 5·5, 9·4, and 20·15 to 1. The rear axle is of live 3/4 floating design, driven by spiral bevel gear. The fuel system includes a U type Zenith carburetter and a petrol pump driven by the engine drawing the fuel from the tank at the rear of the car into a detachable glass container—see Fig. 5—on the petrol pump itself. It passes through two filters, the lower of which comes away with the container and is easily cleaned, and is then drawn up past a non-return valve into the pump chamber, being pumped thence to the float chamber of the carburetter, *viâ* a second non-return valve at the pump outlet. As it is essential that the petrol supply should only equal the amount demanded

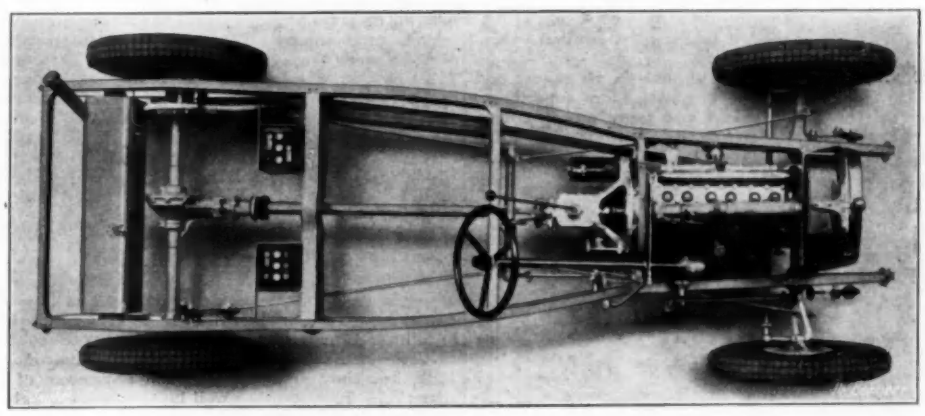


Fig. 3—"Twelve-Six" Chassis—Austin

by the carburetter—no more and no less—although the capacity of the pump is greater than any possible demand put upon it, some automatic mechanism is clearly necessary to regulate the supply and prevent the pressure rising so long as the float chamber is filled. This regulation is accomplished in an ingenious manner by means of link gear on the operating arm of the pump, which "breaks" as soon as the pressure is exceeded, and comes into action again when the pressure falls sufficiently. The pumping stroke is

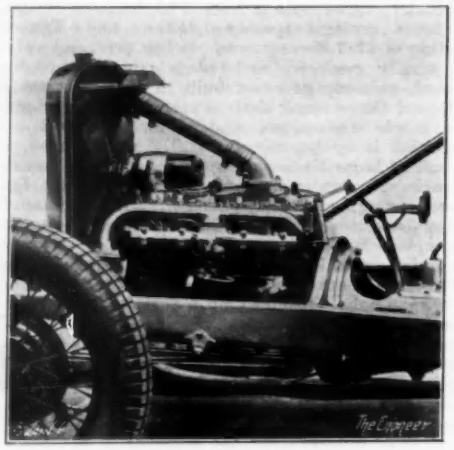


FIG. 4—"TWELVE-SIX" ENGINE—AUSTIN

controlled by a spring of very accurately regulated strength, consequently the petrol pressure can never exceed a predetermined amount.

The coil ignition equipment is provided with an automatic advance mechanism, which relieves the driver of the necessity of constant adjustment of the hand ignition control. Its advantages are particularly evident when accelerating, and during hill climbing the danger of pre-ignition knocking or "pinking" being much reduced. The device is housed in the distributor unit, and consists of a centrifugally operated mechanism, by means of which the ignition is advanced in proportion to engine speed. Very

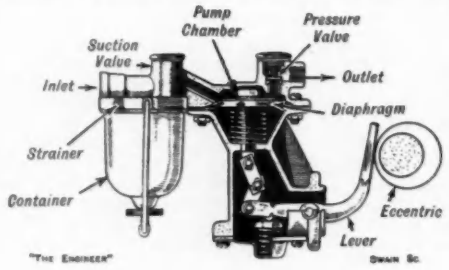


FIG. 5—PETROL PUMP—AUSTIN

little attention is needed to keep the ignition equipment in first-class condition.

This is a really remarkable car for its power and price. The steering and suspension are superior to many of the higher-priced and more powerful cars on the market, and the flexibility of the engine is excellent.

(To be continued.)

The Growth of Cities.*

By FRANK PICK, President.

MANKIND appears to have an inevitable tendency to coalesce into large aggregates. At all times and in all places it has been evident and in these latter times and in certain places it has become a phenomenon of vital concern and increasing moment. It is as if the attraction of the mass increased with the mass, as happens in the physical sphere. The moulding and controlling influence is transport.

The area of Greater London, that is, the area falling roughly within 15 miles of Charing Cross, as a centre, is 693 square miles. Its population, according to the Census of 1931, is roundly 8,000,000 people. It depends for its food, its fuel, its raw materials of industry, for all that makes life possible in such an aggregation, in some small part upon Great Britain, but for the most part upon the world at large. It makes no pretence to supporting itself otherwise than through trade.

One after another the Census returns of the countries of the world are published and afford fresh evidence of the tendency for people to cluster into cities and towns. In 1925 two-thirds of the people of Germany were found to be living under urban conditions; in 1926 half of the French people—in spite of the strong peasant basis of the population. In 1928, in a relatively new country like Australia, two-thirds of the people had chosen to live under urban conditions mainly in the five capital cities of the Dominion. In 1930 the United States of America, which may still be regarded as a new country, showed by its Census over one half; and in 1931 the provisional results of the Canadian Census followed also with over one half in its cities and towns. While Great Britain in the Census of 1931, just concluded, shows so high a proportion as 80 per cent.

The motor vehicle has not stopped the denudation of the country. It has merely spread out the city more thinly. It has urbanised wide belts of country on the fringe of the city, until the break between city and country has become blurred and indistinguishable. It has created a host of fresh problems in the planning and sustentation of cities.

Large cities flourish at the expense of the small cities. All the recent Census statements illustrate this trend. If there is to be aggregation, it is not to be in a series of cities of moderate size, but rather in a few cities of gross size. The small city seems unable to compete. It serves its local purpose so long as its size is kept within narrow bounds. If it aspires beyond its local purpose it fails as a rule to establish itself for any wider purpose. Its industry drifts away. Its amenities prove less attractive or advantageous. Mass attracts mass and the regional or metropolitan city takes its place. Economic conditions appear to grow more favourable with size, as, for instance, in railway rates and charges, or in railway services and facilities, as every railwayman knows only too well.

The extravagant growth is all a matter of the last sixty or seventy years. It coincides with the invention and application of the steam engine for traction purposes in railway and ship, followed by the discovery and use of electricity and later of the internal combustion motor. It is the power of transport that has enabled Chicago to grow to 3,375,000 persons, Berlin to 4,350,000, Paris to 4,900,000, New York to 6,930,000, or with its adjacent cities to 9,000,000, and London in its widest current interpretation, namely, the London traffic area—and the description is significant—to 9,000,000 also. These are truly terrible figures when the provisioning of such cities or the maintenance of their internal circulation so essential to health and productivity is contemplated.

The end is not yet. New York has been taking stock of its prospects and sanguinely expects that the population immediately dependent upon it will increase to 36 millions within a period of forty years. Sir Halford Mackinder, speaking at the British Association only the other day, thought that the London region had a population of 12 millions, and within two generations might look to double it and comprise half the population of England and Wales. It is hard to say that these forecasts are rash, but there comes a time when growth slackens, when the curves that the statistician plots from current results flatten out, and it is doubtful whether these even more terrible aggregations will be realised. It is primarily a problem of transport.

The most striking fact about the local passenger movement in cities is that it is accumulative in character, growing more intense as the city grows more populous. The regional city on the average travels only from 200 to 300 times in each year per head of its population, whereas the metropolitan city travels much more. Taking the five metropolitan cities in order of magnitude, Chicago in 1930 travelled 312 times per head. It is a low and unsatisfactory result and probably incomplete and inaccurate. Berlin travelled 379 times, and so did Paris. London travelled 518 times and New York 575 times. Obviously size stimulates movement. The rate at which life is lived is quickened. That indeed is one justification and purpose of the city. It is a cauldron in the heat of which old ideas are consumed and new ideas flame into being; old notions are fused and crystallised out in new notions.

There is a sense in which an average annual number of journeys per head of the population such as the 575 of New York or the 518 of London is a confession of failure. The transport organisations produce these statistics and take a pardonable pride in their magnitude, but they are not unbiassed appraisers of the situation. It may quite well be that a lower rate of movement were economically more sound and healthy, for the price of the movement in time represents some thirty or more working days or, if the active population is taken as half the full population, some sixty or more working days of eight hours each and the monetary cost, calculated from the fares paid alone, is then some £10. Yet estimates of 600 journeys per head of the population or more were being deemed likely and the prospects of urban transport were being assessed upon such a basis. The sudden reversal of economic progress which is now witnessed affords a suitable moment for the reassessment of these prospects.

There is, regrettably, a fair amount of evidence in the discontent and disorder of the times that the mental and spiritual capacity of the leaders of the people even have not developed sufficiently to manage and control these large aggregations of population. Take Greater London as a test. There are 335 bodies charged with its government in some capacity or other. Its water, its port, its electricity, its traffic, its police, its river, its drainage, its open spaces, are wholly or in part administered by independent authorities. There is no single co-ordinating authority except Parliament, and Parliament can rarely give a little time and attention to it. It is a creature without an adequate brain. It is not easy for anyone to think intelligently in millions, less easy to act in millions, yet that is wanted. London represents a problem not to be solved any longer by letting things alone, but only by grasping all aspects of the problem and planning the result. It is necessary to be familiar with all these aspects to be safe, yet no one has the accumulated experience which affords that familiarity. No one who makes even a cursory review of cities from any angle of inquiry can say that they are intended or planned as they exist to-day. The metropolitan city is the key problem in civilisation and it still escapes solution.

* The Institute of Transport. Extracts from the presidential address delivered in London on Monday, October 12th, 1931.

Railways and Oil-Electric Locomotives.

(From a Correspondent.)

THE Weir Report on Railway Electrification referred to the oil-electric locomotive as "a prime mover of high fuel economy requiring practically no water, while the storage and distribution of water is simple."

When the railways get down to the actual problem of changing their methods of traction, it will probably be found that there are certain lines on which the traffic density, while insufficient to justify the capital cost of electrification, is such as to make the adoption of oil-electric locomotives a paying proposition.

For suburban and heavy main line work, the electric locomotive has certain advantages possessed by no other method of haulage. The principal are:

(*a*) A practically unlimited supply of power to draw upon.

(*b*) A tractor capable of heavy overload and thus of taking advantage of the supply of power.

(*c*) The electric locomotive is fundamentally a simpler machine than either the steam or oil-electric locomotive, and hence the amount of repairs and time annually spent in the repair shops is very much lower.

(*a*) and (*b*) account for the rapid acceleration possibilities of the electric locomotive; (*c*) for its longer life, lower cost of repairs and greater annual mileage.

The capital cost of sub-station and overhead equipment with electrification, however, is so high that other forms of tractors with lower fuel and reasonable repair costs might in some cases prove a better investment than electrification. As indicated in the Weir Report, the most important alternative form of tractor to the electric locomotive is the oil-electric, for the trend of development both in land and air transport is undoubtedly towards the replacement of petrol by crude oil engines. Their application to omnibuses and lorries is making distinct progress. The oil-electric locomotive takes advantage of the fuel economy of the internal combustion engine and the absence of the boiler and fire-box of the steam locomotive. The adoption of electricity for transmitting the power to the driving wheels overcomes the poor torque characteristics of the oil engine.

Before, however, it would be safe for the railways to make a heavy investment in oil-electric locomotives, it is important that further knowledge should be available as to the life and repairs of those at present in use. Fortunately, quite a considerable amount of experience is available from the U.S.A., where there are over 100 locomotives in use in railway work, and also in Canada and the Argentina. Estimates have recently been put forward in the Press purporting to show that if the railways were to abolish steam locomotives entirely and replace them by oil-electrics, they could expect a return of some 14 per cent. on the money so spent. The figures upon which this estimate is based are, however, more favourable to the oil-electric locomotive than experience of users in other countries appears to justify. For instance, while the annual cost of repairs is assumed to be £424 per annum, they have been found in America to vary from £550 per annum on the Central Railroad of New Jersey to £1065 on the Illinois Central Railroad, and neither of these figures would appear to include supervision, upkeep of, and capital charges on, sheds.

The above estimate put forward for equipping British railways with oil-electric locomotives assumes a life of 33½ years for the machine. The two principal manufacturers in the United States take fifteen and ten years respectively for the life of the engine alone; the New York Central Railroad takes eight years for the engine alone and a life of twenty-five years for the machine as a whole. There is, however, not sufficient experience to show that it would pay to keep the oil-electric engine in service for twenty-five years, still less for thirty-three years.

One of the principal objections made in the Weir Report against the adoption of the oil-electric locomotive was that while electrification would seriously reduce the consumption of British coal by our railways, the adoption of oil as a fuel would entirely abolish it. This leads to the question as to whether there

is any reasonable prospect of oil being produced from coal in this country in sufficient quantities and at a price to compare with the cost of imported oil.

It has recently been contended (*vide* correspondence in *The Spectator*, May 30th to July 11th, and *The Times*, July 31st) that the production of oil from coal has now reached a stage when an increase in the demand such as the railway consumption would make,* would render possible the production—on a commercial basis—of fuel oil in this country at a price not higher than the abnormally low price of imported oil prevailing at the moment—say, £3 a ton.

In the opinion of the writer, low-temperature carbonisation and hydrogenation processes do not yet appear to have reached a commercial stage. The production of fuel oil and/or petrol from coal on an economic basis would appear at present to necessitate the sale of the solid smokeless fuel produced for domestic purposes at higher prices than are to-day obtainable, or, alternatively, the imposition of a prohibitive tariff on imported oil. While it is possible that a large demand for crude oil and smokeless fuel from coal would make it commercially possible to produce a good crude oil of only very little lower calorific value than imported oil at about the same market price as is at present paid for the imported article, it is probable that the oil companies are in a position to cut their price if they had to meet the competition of home-produced oil. At the same time, the effect of a tariff upon imported oil would probably do something to assist in its production from coal in this country.

It appears unlikely that either electrification or oil-electric locomotives will be adopted for at least some years on the scale envisaged in the Weir Report. It is, however, quite probable that both forms of traction will be adopted to a certain extent on lines of suitable traffic densities. The two forms of traction are not, in actual fact, exclusive, but the extent to which, and the lines on which, each can be economically employed, have not yet been determined. To settle what traffic densities are most suitable for each of these two types of traction would appear to be the next practical step.

* 405 million gallons of fuel oil, value £3·65 million, were imported in 1928. The total railway demand for oil, assuming the entire replacement of steam by Oil-electric locomotives, is estimated at 1,590,000 tons, or at 63s. a ton, say, £5 millions.

Llanelly Waterworks Extension.

On Thursday, October 15th, the new source of supply of the Llanelly Corporation Waterworks from the Gwendraeth Valley was formally put into service. The population of this manufacturing town and shipping port has steadily increased for a number of years past. In 1831 there were but 4173 inhabitants, whereas last year there were 38,393. The first reservoir built for its water supply was the Trebeddrod Reservoir, which was constructed in 1854, and which had a capacity of 8 million gallons with a gathering ground of 350 acres. It rapidly proved too small for the needs of the district and, in 1865, the then Local Board obtained a special Act of Parliament which authorised the utilisation of the adjoining drainage area within the Lliedi watershed by the construction of what is known as the Lower Lliedi Reservoir—see Fig. 1—which has a storage capacity of 230 million gallons and a top water level of 209ft. above O.D. That work was brought into use in 1878. Subsequently, in consequence of largely increased industrial requirements for further water, Parliamentary powers were obtained to proceed with the provision of a second reservoir—that known as the Upper Lliedi Reservoir—within the same watershed. That reservoir, which has a storage capacity of 200 million gallons, was put into service in 1905. Its top water level is 275·5ft. above O.D., and its construction brought the total available storage up to 438 million gallons. The gathering ground of the Upper Lliedi Reservoir extends, it may be explained, to 2770 acres, while that of the lower reservoir is 1255 acres, making a total of 4025 acres. The total dry weather yield of all the reservoirs is estimated at 3·65 million gallons per day. In the year 1909 Parliamentary sanction was obtained for the construction of open sand filter beds, and additional mains were laid for the separation of filtered and unfiltered waters.

As long ago as before the outbreak of the Great War, the question of increasing the storage within the Lliedi watershed had been under consideration. It was not, however, till 1918 that a Bill, one of the objects of which was the construction of a further reservoir in that area, was presented to Parliament. The anticipated cost was £187,000. The Bill, however, failed on Standing Orders. The year 1919 proved to be disastrous from the point of view of water supply in the district, the rainfall being low and its distribution uneven. In spite of the fact that a certain amount of water could be, and was, purchased from the Llanelly Rural District Council, there had to be very severe restrictions regarding the supply of water during the later months of the year, and it became evident that immediate steps should be taken to avoid a recurrence of such a condition of affairs.

In the August of that year, it came to the knowledge of the late Mr. Kenneth P. Hawksley, M. Inst. C.E., of Westminster, that the Pembrey Munitions Factory would probably soon be on the market, and it occurred to him that the water supply installation, which served that Factory, would prove valuable to the Corporation. After negotiations, the Corporation agreed to purchase the water scheme, which was supplied from within the watershed of the Gwendraeth Fach River, from the Ministry of Munitions at a figure finally agreed with the Disposals Board of £55,575. Consent to promote a late Bill—confirming the agreement—in the Session 1920 was obtained, the Parliamentary Plans being prepared by Messrs. T. and C. Hawksley. It was estimated that the work, which would have necessitated the construction of a new reservoir, and have cost upwards of a quarter of a million of money, would have made available an additional 1½ million gallons of water.

The scheme, as actually carried out, differs in several respects from that proposed in the 1920 Bill, and its total cost has, we understand, been less than £147,000. An additional impounding reservoir has been dispensed with, but, on the other hand, the whole of the new supply has to be pumped. There will, however, it is estimated, be a very considerable annual saving as compared with what would have been necessary had sufficient reservoir capacity to tide successfully over such an adverse period as that of 1919 to be provided.

Actual operations in connection with the extending works and the reconditioning of the existing works of the Gwendraeth scheme were not begun until October, 1928, when a start was made with the preparation of the detail plans. The design of the new and amending works, including the pumping, and their administration during the construction, which was effected under direct labour conditions—approximately 90 per cent. of the labour employed being from among the local unemployed—was undertaken by Mr. Percy S. Spencer, M. Inst. C.E. The particulars contained in the present article have been obtained from a brochure which was prepared for circulation at the opening ceremony, from which also the accompanying map was reproduced. We are indebted to Mr. Spencer for the photographs from which our half-tone engravings were made.

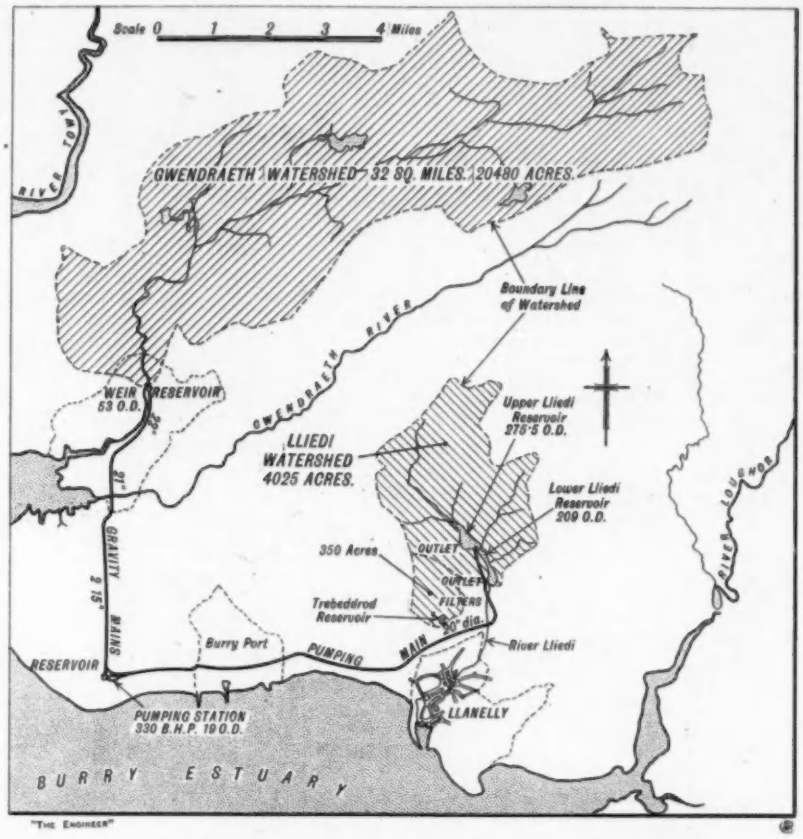


Fig. 1—Map Showing Positions of Gathering Grounds

The drainage area of the Gwendraeth Fach River above the point at which water is abstracted from the stream amounts to about 32 square miles. Water is led from the natural course of the river by means of a dwarf dam, 48ft. in length, which has been built at a point 1½ miles upstream of the Borough of Kidwelly. This dam diverts the water into a sedimentation reservoir, which has a capacity of nearly 500,000 gallons below the crest of the dam. The floor of the reservoir is 8ft. below and the top of the walls are 3ft. above that crest. The water is roughly screened, both as it enters and as it leaves the reservoir, and arrangements have been made by means of which the water can be by-passed round the reservoir at times when it is desired to lay off the latter for cleaning-out purposes. Adjoining the intake works small stilling chambers have been constructed, their object being to calm the water so that that portion of it which it is necessary to send downstream for compensation purposes may flow evenly over the necessary measuring notch, which is of the V pattern with an angle of 90 deg. Half a million gallons a day have to be sent down the river and the flow is, so we understand, maintained within narrow limits, with that volume as a

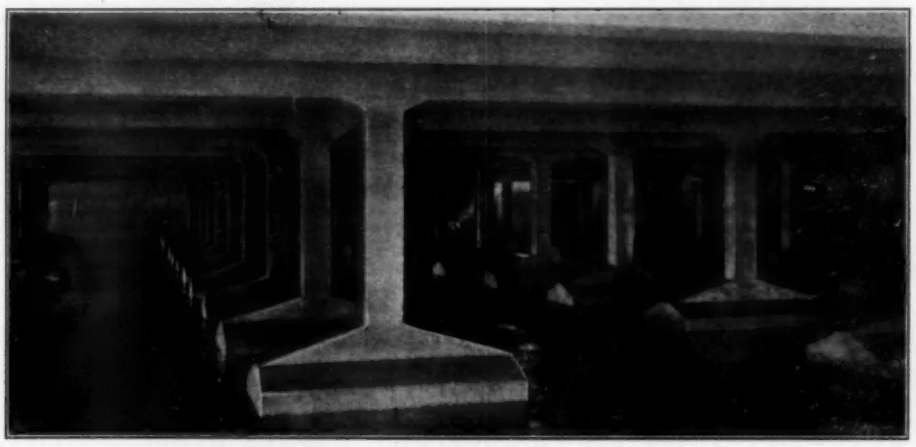


Fig. 2—Interior of Balancing and Regulating Reservoir

minimum, during the variations of river water level, by being caused to pass through a submerged orifice, before entering the stilling chambers.

From the sedimentation reservoir the water passes by gravity through a pipe line to the pumping station, which is at Pembrey, a distance of some 5½ miles. The pipe is first of all 22in. in diameter, and then 21in., while for some distance there are two 15in. pipes laid side by side. The discharge is into a balancing and regulating reservoir—see Fig. 2—which has been constructed adjoining the pumping station. The flow into that reservoir is entirely by gravity, the total available head being 33ft.

The flow from the gravitation main into the reservoir is governed by a hydraulically-operated valve, with a float controlling the operating pressure water. The valve movement is such that, when the water is at overflow level, the valve is shut, while when the water is 12in. below that level the valve is fully opened. The reservoir is 95ft. long by 70ft. wide, and the depth is 4ft. 6in. from overflow to floor. The capacity is 200,000 gallons, and it is anticipated that the surface area is sufficiently great to ensure a gentle closure of the automatic valve during the extreme conditions likely to prevail, so that there should be no possibility of water hammer.

The water on entering this reservoir passes through two sets of fine-gauge wire-mesh screens, the first set having 100 holes to the square inch and the second 400 holes to the square inch. These screens are designed to stop effectively any matter in suspension likely in any way to affect the pumps. The screens can be readily removed by hand for cleansing, and a supply of pressure water is provided to effect the cleansing operation by water jet when they are laid on an adjoining concrete slab, all the swillings being led to waste. At one corner of the balancing reservoir there is a deep sump, which acts as a suction well for the pumps; the reservoir has two overflows, one leading to what is known as the Swan Pool Drain and the other to the sea. The reservoir has a roof of reinforced concrete, which is supported on pillars. The roofing-in is intended not only for the purpose of reducing algal growths to a minimum, but also for preventing deposits of sand during high winds.

The pumping plant—see Fig. 3—forces the water from the balancing reservoir up to either the Upper or the Lower Lliedi reservoir. Its total capacity is the delivery of three million gallons in the twenty-four hours, and it comprises three units, each of one million gallons capacity. There is room in the pumping station building for the installation of a further unit as and when required. The maximum head against which the plant is designed to operate is 375ft., measured at a point 100ft. downstream of the pump-house.

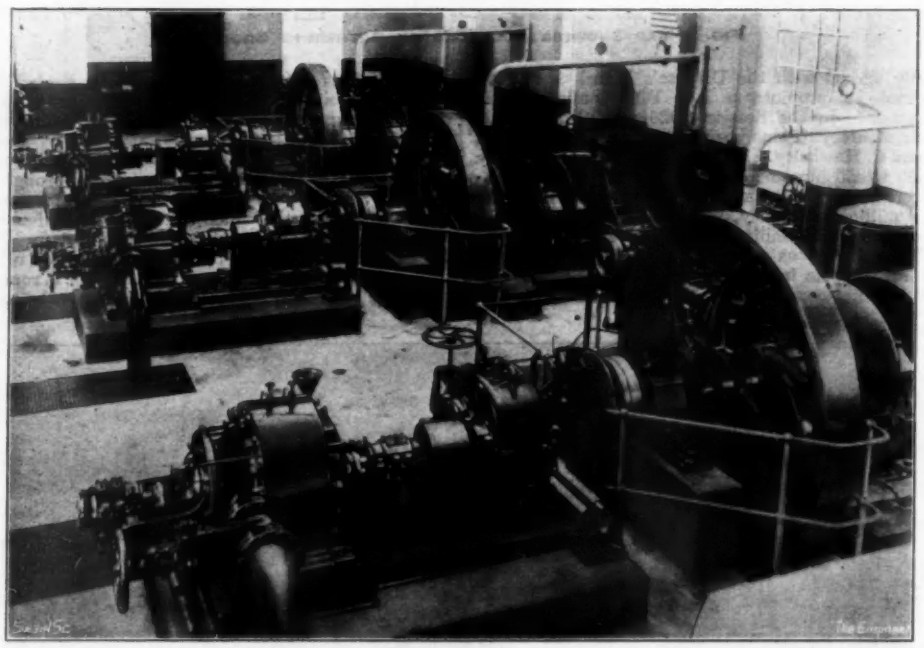


Fig. 3—Interior of Pumping Station

The pumps are of the three-stage Plurovane turbine type, and they are each driven through speed-increasing gearing by a horizontal twin-cylinder crude-oil engine of the spring-injection type, which is designed to develop continuously 111 B.H.P. The principal contractors for the pumping plant were Blackstone and Co., Ltd., of Stamford, who themselves made the engines, the pumps being supplied by Mather and Platt, Ltd., of Manchester, and the gears by David Brown and Sons, Ltd., of Huddersfield. Pumping operations will only be carried on when the water in the Upper and Lower Lliedi Reservoirs falls beyond the limit fixed as appropriate for any particular period of the year, so as to ensure the utmost economy in pumping costs consistent with a satisfactory margin of safety.

The maximum speed of each of the engines is 266 revolutions per minute, while the maximum speed of pumps is 1450 r.p.m. These speeds can be reduced to suit the head to be pumped against, the engine speed being reducible down to 214 r.p.m. without greatly lowering the efficiency as regards fuel consumption. Storage tanks, in duplicate, each of 3000 gallons capacity, are provided to contain the fuel oil. The cooling of the engines is effected on the thermo-syphon system, assisted by passing the hot water through "Serck" coolers when the engines are in motion, this arrangement having been adopted in preference to the provision of water-cooling towers. The auxiliary machinery in the pumping station includes an air compressor and a ram pump, both arranged to be driven by belt from the same Blackstone 5 H.P. petrol engine, the pump being used for withdrawing the water from the sump in the balancing reservoir, which cannot be emptied by gravity; an electric lighting set of 1½-kW capacity to generate current for the internal lighting of the building; and a streamline filter through which all the lubricating oil is passed after use. There is also a travelling crane of 5 tons capacity, supplied by Herbert Morris, Ltd., of Loughborough, and, in addition, a set of ½-ton blocks. These lifts can be concentrated at any point within the station.

The rising main from the pumping station to the reservoirs within the Lliedi watershed is of cast iron, and is some 8½ miles in length. It is 20in. in internal diameter throughout, and its capacity is 3 million gallons per day, which, it is anticipated, will be maintained for the next twenty-five years, as the looked-for fall in head due to friction by the usual causes has been allowed for. Incorporated in this pumping main are:—(1) A Venturi meter, supplied by Guest and Chrimes, Ltd., of Rotherham—which company also supplied the valves—which is inserted at a point 100ft. downstream of the pumping station; (2) five sluice valves with spur gearing; (3) automatic air valves at high points and 6in. diameter scour valves at low points; and (4) three reflux valves to act, in emergency, as a safeguard against flooding. There is also a relief pressure valve, which affords instant relief on opening, but is regulated for a time interval of closure.

There are outlets from the rising main, both at the Lower and Upper Lliedi reservoirs. Each is of different design, the former, as it has to deal with the control of water under higher pressure than the latter, being provided with a stilling chamber. The water is seen entering the Upper Reservoir in Fig. 4.

The pipes and special castings in the pumping main were supplied by the Stanton Ironworks Company, Ltd., of Alfreton, near Nottingham. The total weight was approximately 4500 tons and the cost was £33,300. The cost of the valves, meters and ironwork amounted to £1900, and that of the pumping machinery to £6210. The excavation and pipe-laying, the construction of the Reservoir and masonry works, and the building of the foundations for the machinery were all executed by direct labour. The amount of money paid in wages to workpeople employed directly on the scheme since 1929 has amounted to nearly £26,000, and local employment has been helped considerably by the purchase, whenever possible, of materials within the district.

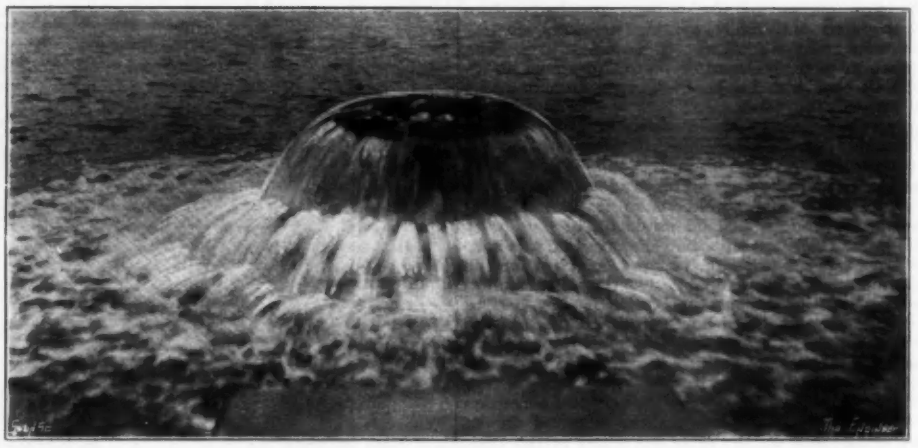


Fig. 4—Water Entering the Upper Lliedi Reservoir

CANADIAN ROADS AND HIGHWAY TRAFFIC.

The annual Convention of the Canadian Good Roads Association was held at Lucerne, Quebec, on September 22nd and 23rd, with an attendance of over 300 delegates. The Hon. J. E. Perrault, the President, in his opening address, said that the Association had done much for highway development in Canada, and looked forward to the adoption of uniform laws so that there might be complete co-operation between the different provinces in regulating highway traffic. Mr. S. L. Squires, of Toronto, the chairman of the Executive, contended that, as the cities benefited more from highway construction than the rural centres, they should pay a larger proportion of the costs. The cities, he urged, had obtained the greater share of the money spent by tourists, who were encouraged to come by good highways.

Tourist traffic was discussed by Mr. C. L. Burton, of Toronto, who cited an estimate of the Dominion Bureau of Statistics that tourists had expended 1,600,000 dollars in Canada during the past seven years, and said that he anticipated that that amount would be largely increased by continued highway improvement and especially by the completion of the trans-Canada Highway. Mr. William Findley, of Toronto, advocated the construction of light summer roads in resort territories, particularly in the natural parks for the use of tourists.

The subject of motor accidents at level crossings was dealt with by Mr. A. D. Ferguson, of the Bureau of Economics of the Canadian National Railway, who claimed that such accidents were due to the carelessness of motor drivers, and that motor owners should pay for the cost of the elimination of these crossings. The Hon. Frank Oliver, who is Advisory Officer of the Board of Railway Commissioners, stated that the menace of level railway crossings was receiving special attention from the Commission, and that the Dominion had at present over 28,000 level crossings, although 1,180,000 dollars had been spent on their elimination and improvement. It would be impossible entirely to remove all the level crossings, and caution on the part of drivers would prevent the great majority of those terrible accidents.

Papers were also read by Mr. E. H. Scott, manager of the Asphalt Association of Ontario, on the trend of practice in asphalt, and by Mr. Patrick Phillip, Deputy Minister of Highways for British Columbia, on creosoting timber for highway structures.

The following officers were elected:—President, the Hon. S. C. Stewart, Minister of Railways for Saskatchewan; First Vice-president, the Hon. Hibbs, Minister of Public Works, Newfoundland; Second Vice-president, the Hon. W. R. Bruhn, Minister of Public Works for British Columbia; Third Vice-president, the Hon. Leo. MacAulay, Minister of Highways for Ontario. Directors: The Hon. W. Findlayson, Minister of Lands and Forests for Ontario; the Hon. Leonard MacNeil, Minister of Highways for Prince Edward Island; Mr. Justice Fullerton, Chairman of the Board of Railway Commissioners; Mr. Charles M. Black, President of the Royal Automobile Club of Canada, and Mr. J. D. Stewart, General Manager of the Canadian Automobile Chamber of Commerce.

Perkins' Hermetic Tube Boilers.

By CHARLES R. KING.

In a very finely illustrated catalogue of A. M. Perkins and Sons, Ltd., 1898. it is stated that "in the year 1831 Mr. A. M. Perkins took out his first patent for what is universally known as Perkins' system of heating by small-bore wrought iron pipes."

But hermetic tubes had been used about 100 years ago. The boiler shown in this patent, which is No. 6146 is very much in the form which is still to be seen in various London installations, and as it has been made on a commercial scale since that date up to the present day.

The specification describes this closed-cycle hot-water heater as adapted for sugar-making and refining, for evaporators, for steam boilers, and also for various processes requiring molten metal for the treatment or working of other metals at the very high temperatures obtainable from the hot water circulating in the closed pipes.

As illustrated in this specification, it appears as a combination of several parts that had already been used by Jacob Perkins and of the several standard parts characteristic of the later arrangements introduced by Angier March Perkins; for example, the hot water coil and the central, top-feed furnace, with its fire-brick surround and annular cavity for the pipes, is a repetition of the supersteam producer-fired boiler of 1823, but naturally without the central superheater, and without the J.P. loaded "pressure valve." It also utilises the Jacob Perkins' patent double-cone unions, pulled up water-tight by means of bolts and bridles or lugs; and the "expansion tube"—for which the joint is here employed—has the domed ends, like oxygen tubes, as in the earlier Perkins' vertical steam drums. The chief "A.M.P." feature shown in the patent is the right and left-hand screwed pipes and socket as they are still used; and precisely as illustrated in Stewart and Lloyds most recent catalogue of "Perkins' pipes" tested to 4000 lb. per square inch hydraulic.

1831.

For heating boilers or evaporators the drawings show the "grid" type serpentine loops as still made; and also the loops on the "closed water-tube" for the melting of metals in baths. With but a limited number of forms for these closed-cycle heating pipes, this 1831 patent is, nevertheless, the basis of all which have since followed, except the "stopped-end" hermetic tubes designed by Jacob Perkins, which followed five years later.

The tubes were made wholesale by Russell and Son, of Wednesbury, Staffs., and the cast iron furnace fittings by Carron and Co. The essential feature for practical convenience then, as now, was the "A.M.P." screw sockets.

The old principle of the ever full water boiler, as devised in the United States by Jacob Perkins to prevent the formation of a film of bubbles against the metal when subjected to extremely high temperatures, is re-applied in these hermetically sealed heating tubes, for the specification says:—

"As water expands about one-twentieth of its bulk before being converted into steam, I provide about double that extra space in the 'expansion tube' which is fitted with a removable air plug to allow the escape of air when the boiler is being filled. With this space for the expansion of the heated water the boiler is completely filled, and will at all times be kept in constant contact with the metal, however high the degree of heat such apparatus may be submitted to; and at the same time there will be no danger of bursting the apparatus with the provision of the sufficient space as named for the expansion of the water.

"I find that when the circulating tubes present a surface equal to three times that of the heating coil, I have not been able to burst the tubes.

"The tubes I use are called drawn gas tubing, and the size I commonly employ is 1in. external and ⅝in. internal diameter."

The joints are made with the tube ends screwed for right and left-hand threads, brought together in a strong water-tight joint by simply screwing up the coupling piece or socket on their ends.

1835.

To whom, and for what processes, these heating apparatuses were supplied in the next few years is not known, but the books of the firm in 1835 at least prove by the numbers of sets produced that already they were employed at home and abroad, as appears from the following, written in the old "Materials Received" book salved from No. 41, Water-lane:—

Apparatus supplied to:—Chancery Court, Lincoln's Inn; British Museum; Adelaide Gallery Steam-Gun Company; Escher, Wyss and Co., Zürich, including pipes, "expansion coil," hydraulic pump; through Mr. Lemme, Finsbury-circus, consignment for Brussels, "Expansions," tees, plug and nuts; Gray's Inn Chapel; Perkins, Bacon and Co. refacing steel dies; Zoological Gardens; Albion Cloth Company, Abercromby Port; Justiciary Court, Edinburgh, &c.; followed in later years by Soames Museum; Marlborough House; Courts of Justice; Guildhall; Kew Gardens, and the mansions of many great country seats—concerning which the copy letter book of Angier March Perkins shows that he was an adept on problems arising when planning heating installations.

As is known, the same system was much later installed on the Tower Bridge, and is still employed, it is believed, for heating Transandian trains at altitudes when the steam locomotives cannot spare steam for train heating, and even oxygen is carried aboard for cases of difficult respiration.

Passing now over the later hermetic tube steam heating systems—1836—that were invented by Jacob Perkins, the next development by Angier March Perkins was an elaboration of processes of steam generation by means of hot water in closed-cycle pipes, as patented in 1839.

1839.

In 1839 most of the well-known forms of A. M. Perkins' hot water hermetic heating tubes were patented under No. 8311 for every class of heating; whilst a concentric tube boiler came into popular notice from that date through the spectacular displays of rapid machine gun firing at institutes in Manchester and Birmingham, and at the Polytechnic Institute, London, which continued their performances for many years later as an attraction to young people of a scientific turn of mind.

The same steam that fired the projectiles could haul the guns and manœuvre them, and also spread smoke fogs; yet although three generations of Perkins persisted in urging steam in place of gunpowder, there is no record of steam being used thus, other than experimentally in France. But the same steam closed-circuit tubes were generally employed by the Army for field bakeries and were so used during

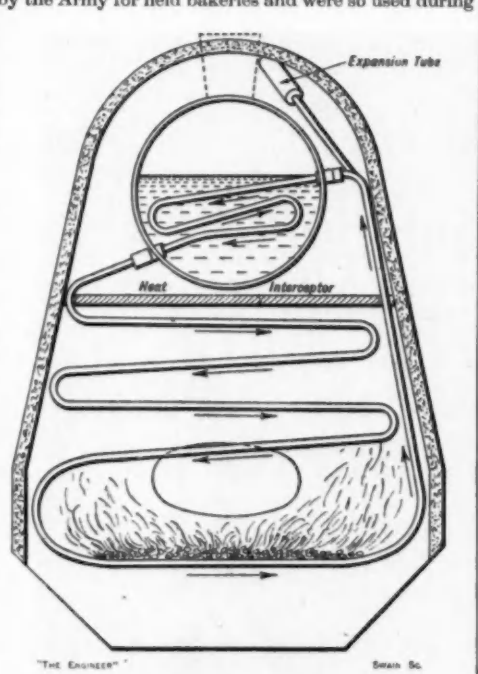


FIG. 1—PERKINS' BOILER

the Great War. The application of these hermetic heating tubes to locomotives and marine engines does not appear to have been noticed in any journals, and only by chance in pamphlets which referred to the system.

The hot-water closed-circuit heating pipes in this concentric tube system are fork-ended, and dip into two or more steam generation tubes. These resemble locomotive superheater elements so much that any modern application of this system for large boilers would consist of so many large "fire" tubes, all stopped at one end and traversed by the inner, hot-water tubes—as in the Perkins or so-called "Field" system—and then connected up externally by U bends and secured steam-tight to the outer tube ends by coned reducing sockets. This is undoubtedly the most rapid supersteam generator operated with closed-circuit hot-water tubes that was ever made by the Perkins firm, and, with successive improvements, continuing up to the time of the Civil War in America, when Perkins and Son offered to supply rapid-fire magazine machine guns on this principle to the Federal Government, in guaranteeing them to equal the efficiency of the best Minié rifles of that day, but at a much lower cost for coal than for gunpowder.

According to a brochure issued in 1840 by the Directors of the Birmingham Mechanical Institute:—"This new method of producing steam has been applied by Mr. A. M. Perkins with perfect success in marine engines . . . it gives a surprising economy of fuel and a rapid generation, with lightness and compactness of form; and a uniform pressure of from 200 lbs. to 800 lbs. per sq. in. may be obtained by its use."

With the exception of recent applications to locomotives, it is possible that few working engineers could to-day give any account of actual personal experiences in the operation of two-pressure, indirectly heated steam boilers. For this reason, the following account by Mr. J. A. Langridge, the engineer-in-charge at Messrs. Heal's furniture works in Tottenham Court-road, London, may be found interesting. It refers to that class of boiler patented in 1839, but with its heating tubes placed transversally to the boiler, and with the furnace gases rising, not descending. "From the year 1907 up to 1915 when the Heal premises were rebuilt, I had charge in the bedding department of two Perkins hermetic tube, closed-circuit steam boilers for supplying power and process steam. In 1915 the largest one of these had been in use for sixty-five years, and the other, smaller one, for forty-three years. Both were of the same general construction as shown in Fig. 1. The last one, which we always called 'the new boiler,' had closed heating tubes about 1¼in. external diameter and ¼in. bore, as against 1in. bore in the older boiler. The drum containing the free water for evaporation was about 18ft. long, egg-ended, and about 54in. in diameter and traversed throughout its parallel length and below the mean water level by forty-eight closed-circuit heating pipes, or internal loops, so bent as to carry the hot water current to a lower level before leaving the boiler, and connected to the outside elements through the Perkins screw sockets, the boiler joints being made water-tight by flanged collars embracing the boiler plates and the cover strap. The hot water elements, bent in the form shown in the photograph—Fig. 2—and so forming the fire-box in their two lowest laps, made the complete circuit with no more than two joints placed at the hottest and coolest points on the boiler.

"From my previous experience of firing locomotive boilers—London, Brighton and South Coast Railway—and Davey-Paxman and Babcock and Wilcox boilers—City of London generating station—I was much struck with the rapidity of the steam generation in this Perkins closed-circuit heating system, which was astonishing to me, for it was my first experience with this class of boiler. When the yearly inspection took place and the steam drum was opened up, I was surprised to find such a short length of tubes available for heating inside; but I found the usual average of scale on the plates and on the heating tubes below the water line—that is, from ¼in. to ⅛in. thick. The water used was nearabouts one-half from the service main of the New River Company and the other half from a tank to which the condensate of the heating pipes of the building was returned. Caustic soda was used in the boilers, this being put into the pumping tank. No fusible plug was used in these boilers, as no flame could reach them, there being a thick iron plate laid on the brickwork above the whole flue area immediately under the egg-ended boilers. Coke was always used as fuel, and, as judged from their appearance seen from the firing door, the tubes seemed to be normally red-hot, and this, with the very rapid rise of pressure in them, was, at first, disquieting to me. But the pressure dropped with almost equal rapidity when the fire door was left open and then rose swiftly when the door was again closed.

"The usual practice was to leave the door open for a few minutes when the steam gauge rose to 1150 lb. per square inch.

"The safety valve was then set for 1250 lb., and at this pressure a tell-tale alarm bell rang. At the points of connection of the hermetic tubes to the drum there were no tees or elbows, but simply an easy bend in the pipe and sockets, having Angier March Perkins' right and left-hand threads and a copper washer to bite on between the ends of the pipes, which were brought up to a close joint by turning the sockets by means of long tongs, as there were no cants or flats on these sockets as with the union nuts now used. The drum was thickly strapped at the level of the sockets.

"When I took charge of the boilers the working pressure for both drums was 50 lb. per square inch, but about the year 1912 the Vulcan Insurance Company ordered the older boiler to be put out of use. As this threw too much extra work on the 'new' boiler—since all the show-room and factory heating and process work was done with live steam, and as the new factory was not ready—we stripped the old boiler of brickwork and cleared the drum and drilled it, and asked the insurance company to reconsider the matter, with a view to its working a few years longer. We found the plates in the older boiler, when new, had been ⅝in. thick, and in the newer one ½in. thick. The thinner plates were much corroded in places. Finally, it was agreed that the older boiler might continue at 45 lb., so both remained in use until 1915, when they were broken up *in situ* to facilitate their removal to Cohens.

"I particularly noticed that when the heating tubes were cut from the steam drum they were quite clean inside.

"The state of preservation of these tubes was wonderful, and there never had been any trouble with leaks, although they were, I was told, the original ones made with the drums.

"The tubes were set crosswise as fire-bars in the furnace, and, as they were far from level, one could not help striking the higher ones with the clinkering dart and rake, as used twice daily throughout all those years. I was often in the fire-box sweeping down the heating pipes, and observed no sign of

pitting or of burns; they looked, on the contrary, more like burnished steel.

"Yet I considered the 'new' boiler was subjected to severe wear and tear as regards these heating tubes, for it supplied process steam under trying conditions. Both boilers stood side by side, and in their flues, which ran along the brick setting just above the fire-box level, were four lines of 6in. cast iron pipes, separated by vertical intervals of about 4in., out through which the gases were drawn sideways in so leaving the uppermost laps of the hermetic heating pipes to be warmed by the natural ascent of the heat. Through these cast iron pipes the air was drawn in circuit by a fan which blew the hot air into a feather dusting machine, working in the bedding factory. The fan, with four blades, turned at 2000 r.p.m. to create a strong draught in order to beat the dust from feathers sealed up in a wire gauze cage. This hot draught with the dust was driven back through a separate flue into the ashpit of the 'new' boiler, and then we had to keep the ashpit doors closed completely air-tight, for the boiler fire increased to a white heat when the feather dusting machine was at work. The firing door had then to be kept open for a part of the time in order to allow cold air to flow over the hermetic pipes, and so abate the fierceness of the heat, and keep down the pressure in the heating tubes. This had been going on, so far as I could gather, during the whole life of the boiler, and yet, although these conditions did not appear favourable to long endurance, no trouble had arisen with the heating tubes. The boilers worked with very little smoke, and the stack in this crowded neighbourhood was only 28ft. high.

"The steam of 45 lb. working pressure was used to drive a beam engine, the exhaust from which passed through a series of pipes enclosed in a steel revolving cylinder to dry the feathers after they had been steamed prior to passing to the dusting apparatus. The two boilers were used, turn about, for power or for process work, just as happened to be most convenient. There was never any difficulty in keeping a head of steam, but rather the reverse, so that in later years the work on the boilers was increased by an extension of the live steam heating, and for hot water in the domestic services. During the eight years that they were in my charge nothing was replaced or renewed in these boilers except in the condemned steam drum, which I drilled, tapped and plugged. The heating tubes were never touched. The only attention given them was to pump them through by hand and fill them up with fresh service water. For this job the practice was to pump the heating system full up and then to remove the plug from the extreme end of the expansion pipe, still continuing to pump so as to make sure the expansion pipe was clear; then to take out the lower plug—which would be about 3ft. below the top of the expansion pipe—and continue pumping until a solid volume of water, without air, came through. The pumping was then stopped and the valve closed from the pump to the heating system, but waiting still a few minutes longer for water to come down to the lower plug hole before replacing both plugs, which were caps, screwed and loaded with lead. When kindling the fire the water could be heard circulating directly a shovelful of hot coals was put into the furnace. This pumping-through business could be begun and finished within an hour. As to the time taken to get up steam, it should be mentioned that for insurance purposes the fires were drawn every day after work, and on the first day of the week there would be practically cold water in the drum and new water in the heating elements, so then it would be about one hour from cold up to full pressure, provided all valves for the heating plants on premises were closed; but it was usual to start up by allowing the first hot water to circulate away through the premises until the engine was due to work, when one boiler could be connected up for driving the engine and the other let out for steam processes. From this time it only required a few minutes to bring the power boiler up to the blow-off point, and for ordinary normal working it sufficed to have 900 lb. per square inch in the heating elements. For these reasons I never experienced the usual 'Monday-morning' anxiety of being late in starting engine from cold to working pressure.

"As to an estimate of the steam consumption for a given work by these boilers, that could not be given with certainty owing to the variations with machines in and out of work and the variations in the steam demand for process operations at different times; but, in a general way, I must say that, in my opinion, the boilers in question were light on the water consumption; and my experience with them sometimes leads me to wonder why such an efficient system of generating steam has been allowed to become extinct."

The extreme simplicity and relative cheapness of this indirect heat-transfer boiler is very striking when compared with some recent derivatives, and it will be observed that there are not more than two joints to each heating element where six joints are now employed. A view of the interior of the boiler, taken in 1888, is reproduced in Fig. 2.

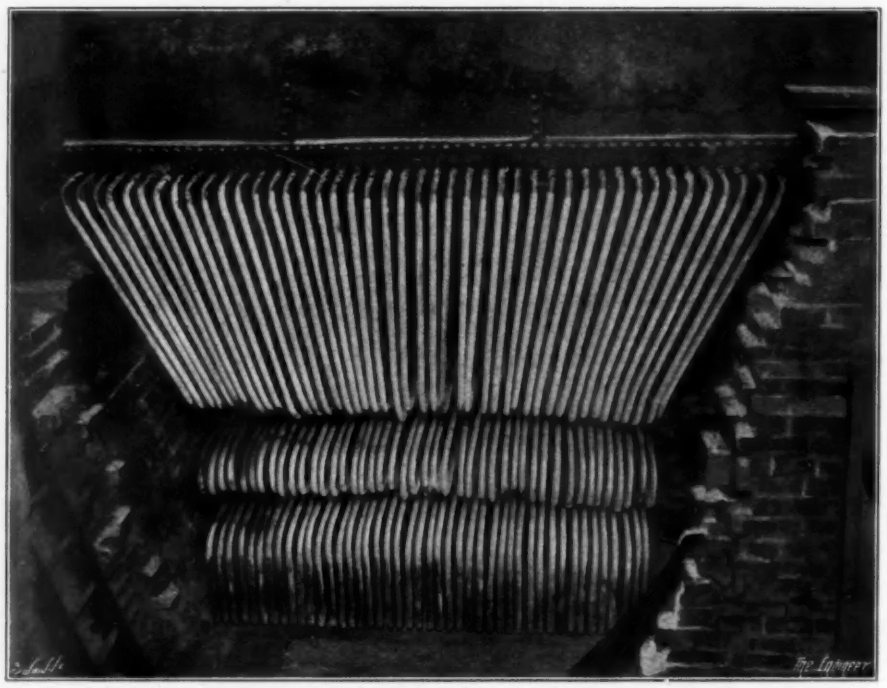


FIG. 2—PERKINS' HERMETIC TUBE BOILER AT MESSRS. HEALS, 1888

Of two Perkins boilers still working in the Guildhall, one is said to have been in use for about eighty years, and the chief engineer states that the pipes have not lost one-sixteenth of their original diameter. The farthermost heating outlet does not necessitate a boiler pressure of higher than 800 lb., and the pressure gauge is only for 1000 lb.

It appears that the fan engine, still running, was supplied with steam from a source which the engineer could never trace and which could not, of course, be from the heating water in the closed circuit pipes, but as the steam supply became deficient and no forcing of the heating system appeared to increase it, an ordinary steam boiler was later on provided to supply the fan engine.

These Perkins' tubes for 4000 lb. per square inch are shown in Stewart and Lloyds' catalogues with the A.M.P. patent r. and l. screwed union sockets. They are now made for yet higher pressures and hydraulic tested to 5 tons (11,200 lb.) per square inch; but even at this proved strength they are occasionally burst, through the negligence of some attendant, oftentimes a night watchman; but the absence of steam drums containing a large body of water on the closed circuit explains the peculiar safety of boilers that are designed strictly according to the patented systems of Jacob and A. M. Perkins; and with which no serious accident or loss of life occurred from 1832 to 1882, with daily heating pressures of 2000 lbs. per sq. in., according to the minutes of the Inst. C.E., Vol. LXVII., 1882.

STOPPED-END TUBES, 1836.

Angier March Perkins appears never to have used stopped-end tubes, a system which was invented later on in the development of the hermetically closed-tube boilers by Jacob Perkins; but both these systems remain in use to-day. The prototype of the Perkins' hermetic stopped-end heating tube was his own invention of what, thirty years later, became known as the "Field" tube—because Field made use of it. This "Perkins' tube"—open to the boiler water—was patented by Jacob Perkins in 1831, No. 6128, as a means to develop the crown heating surface in fire-boxes or in wagon type boilers, and a French patent for it was secured under the name of St. George, of London, dated April 24th, 1833.

In France, thirty years later, it was adapted as a locomotive fire-box superheater.

By prolonging his "1833" tubes upwards through the water space and sealing them down tight with a plug screw, placing a very small dose of water inside, which could never evaporate, he made the first "stopped-end" tube, as it is called in the trade to-day. To determine the dose of water it sufficed to know the interior volume of the tube and find the weight of water for that volume in steam at a given pressure. The Perkins' patent for these tubes is No. 7059, April 12th, 1836.

The general description of the boiler is given as follows:—"One end of each tube projects downwards into the fire or flue and the other part extends up into the water of the boiler; each tube is hermetically closed to prevent escape of steam. There will be no incrustation of the interior of the tubes and the heat from the furnace will be quickly transmitted upwards. The interior surfaces of the tubes will not be liable to scaleage or oxidation, which will, of course, tend much to preserve the boiler so constructed. The specification says:—"These tubes are each one to have a small quantity of water depending upon the degree of pressure required by the engine; and I recommend that the density of the steam in the tubes should be somewhat more than that intended to be produced in the boiler, and, for steam and other boilers under the atmospheric pressure, that the quantity of water to be applied in each tube is to be about 1:1800 part of the capacity of the tube; for a pressure of 2 atm. to be two 1:1800 parts; for 3 atm., three 1:1800 parts, and so on, for greater or less degrees of pressure, and by which means the tubes of the boiler when at work will be pervaded with steam, and any additional heat applied thereto will quickly rise to the upper parts of the tubes and be given off to the surrounding water contained in the boiler; for steam already saturated with heat requires no more (longer) to keep the atoms of water in their expanded state, consequently becomes a most useful means of transmitting heat from the furnace to the water of the boiler."

A very important improvement was afterwards made by Perkins, and patented later in 1836, No. 7242, in extending the tubes up to tops of boilers and fire-boxes to serve also as stays. All modern makers have followed this plan.

The use of the Perkins' hermetic tubes for crown stays was doubtless suggested during the actual construction of the first indirectly heated locomotive boilers. The actual boiler was more like a very long Belpaire-top fire-box.

Locomotives with hermetic tubes for the Southampton Railway were erected under the personal supervision of Jacob Perkins at Southampton between October, 1836, and November, 1837, when he was over seventy-one. They were operating only eight years after the "Rainhill" trials, and when the Trevithick type locomotives of Fenton, Murray and Wood (1813) and of Stephenson (1827) were still giving satisfactory service. The materials used in the construction of the Southampton engines are detailed in the firm's books under the heading "Sent to Mr. J. Perkins at Southampton:—1836. Novr. 23, &c."

Perkins recommended for his indirectly heated locomotives a working pressure of not less than 200 lb. per square inch, and cylinders so designed as to give the requisite power at a cut-off of one-eighth—12 per cent.

From experience obtained with the new hermetic tube boiler Jacob Perkins calculated that it would make the trip London to Birmingham without stop for water or for coal, and without need to clean the grate or to sweep the tubes. He mentions that a contemporary railway engineer of authority had stated that locomotives should have their furnaces cleaned every 30 miles.

At the Institution of Civil Engineers, February 7th, 1837, he stated that "a boiler generating steam on this principle has been under the action of fervent heat during the last seven months without the least leakage or incrustation." "There is no deposit of any kind in the hermetically sealed tubes, and that which would deposit in the boiler is perfectly swept off into the recipient by the rapid circulation." In February, 1837, he was still engaged erecting locomotives at Southampton.

The subject was introduced at the meeting by his admission that furring up of the tubes while using ordinary calcareous water had been a regular trouble with his supersteam cast iron bar boilers. "I have, however, recently been so fortunate as to remove all objections by a new modification of the generator—*e.g.*, hermetic tube—and I have good reason to believe that a voyage might be made to India and back without finding the boiler in the least foul or perceptibly fireworn.—Jacob Perkins."

Survey of the River Tees.

We have been favoured with a copy of a Report made by the Water Pollution Research Board of the Department of Scientific and Industrial Research, recently presented as Technical Paper No. 2, and entitled "Survey of the River Tees: Part I., Hydrographical."* Our readers will remember that this Board was set up in 1927 to meet—to use the words of the preface to the Report—"the need for research bearing on the application of practical methods and the scientific developments of new methods of avoiding or minimising the pollution of the rivers and other water supplies of the country by industrial effluents and sewage." One of the first conclusions that it reached was that reliable information was urgently required as to the effects on rivers of various polluting discharges, and it recommended that a comprehensive scientific survey of a typical river, flowing through an industrial area, should be undertaken. The reason given for this recommendation was that, while it was known that rivers which had received polluting liquids are capable of self-purification under certain conditions, there was a lack of exact knowledge of those conditions and of the quantities of various effluents which could be allowed to enter a river without unduly retarding the processes of self-purification. After full consideration it was decided that the River Tees afforded the main characteristics desirable in a pioneer investigation of this kind, and accordingly the work of the survey of it was begun in April, 1929. The Report, which we discuss in what follows, is the first outcome of the work of the Board to be published.

The survey was divided into two main sections, comprising the tidal and non-tidal reaches of the river respectively, and the investigation of the tidal reach was further subdivided into two sections, the one to secure hydrographical data and the other to obtain biological and chemical information. The survey of the non-tidal reach was carried out for the Department by the Ministry of Agriculture and Fisheries, while the biological and chemical surveys of the tidal reach are being carried out for the Department by the Marine Biological Association of the United Kingdom. Arrangements have also been made with the Meteorological Office of the Air Ministry to furnish data of the rainfall within the watershed of the Tees throughout the period of the survey. The agreed programme of the hydrographical work having been completed, it was felt that the results of it should be made public at once in the present report, rather than wait for the completion of the biological and chemical surveys, which are likely to occupy some three years.

Objectives of the Hydrographical Survey.

The interpretation of the results of the biological and chemical work, which is now in progress, involves, it is pointed out, a knowledge of the flow of the fresh water of the upper river, and of the movements of the fresh and the saline water in the estuary. The principal objects aimed at in the hydrographical survey were, therefore, to obtain detailed information regarding the tidal movements in the River and its estuary, with special reference to the following points:

(1) Strengths of the currents and the volumes of water moving up and down the River at different times and places over all ranges of the tide and at all depths.

(2) The general movement of the water between Stockton and the sea.

(3) The effect of fresh water floods on tidal movements in the estuary.

(4) Comparisons of water level at different states of the tide; and

(5) Times and heights of High and Low Water throughout the estuary.

General Description of the River.

The Tees rises on the slopes of Cross Fell, and pursues a fairly straight course for about 54 miles as far as Croft Bridge, which is approximately 42 miles by river from South Gare Lighthouse, at Tees Mouth. Beyond Croft Bridge it follows a winding course as far as Middlesbrough, where it opens out into a broad estuary, and reaches the sea 6 miles further on. Several tributaries enter the river at various points, and, of those which join the main stream below the tidal limit, the Leven is the most important. The tidal limit, that is to say, the highest point up the river where tidal influences are felt, is near the village of High Worsall, a distance of about 25 miles from the mouth.

The tidal investigations were confined to the section of the river between Stockton and the mouth, a distance of about 12 miles by river. It is that part which is mainly affected by pollution, the untreated sewage of Thornaby, Stockton, Middlesbrough, and of the growing population of Billingham being discharged into it, together with the effluents from a large number of manufactories. In this section, ten stations at which to make a complete investigation into the movements of the water at all states of the tide, were selected. The positions of these stations are indicated on the accompanying sketch map, which is reproduced from the Report, the distances between them being shown in feet.

Fresh Water Observations.

Before carrying out current and tidal observations below Stockton, it was necessary to arrange for continuous observations to be made of the fresh water passing down the river at some point above the tidal limit. For that purpose a water level gauge was set up at Croft Bridge, which is 17 miles above the tidal limit. It is explained that, for various reasons, the river at that point is not ideal for current observations—which were carried out over a measured distance of 100 yards just above the bridge—but that it was the best place that could be found below the junction of the River Skerne, and it possessed the advantage that a level gauge could be constructed on the bridge. The zero of the gauge was 84·5ft. above O.D. (Liverpool). Readings of the water level were begun in April, 1929. They were taken regularly twice daily—in the morning and afternoon. Current observations were made at intervals over the measured distance, and a cross section of the river was made near the centre of the measured distance to enable the necessary calculations of volume to be made.

The observations at this point served a double purpose:—(1) They provided data for estimating the volume of fresh water entering the river, and (2) they also furnished information regarding the passage of fresh water floods down the river; so that, when exceptional conditions, which would vitiate the results of current observations in the estuary, prevailed, the work in the estuary could be temporarily suspended until the flow of fresh water again assumed normal proportions. The Report contains references to some of the fluctuations observed in the level of the river, but it will not be necessary for us to go into them in detail. It will suffice for us to mention that the discharge of the river is only temporarily—a matter of a few hours—affected by heavy rain.

From observations between April and December, 1929, it was concluded that the average heights of water on the gauge and flows in the river at Croft Bridge might be taken as:—

(1) Normal summer level = 1ft., the corresponding discharge of fresh water being at the rate of 100 million gallons per twenty-four hours.

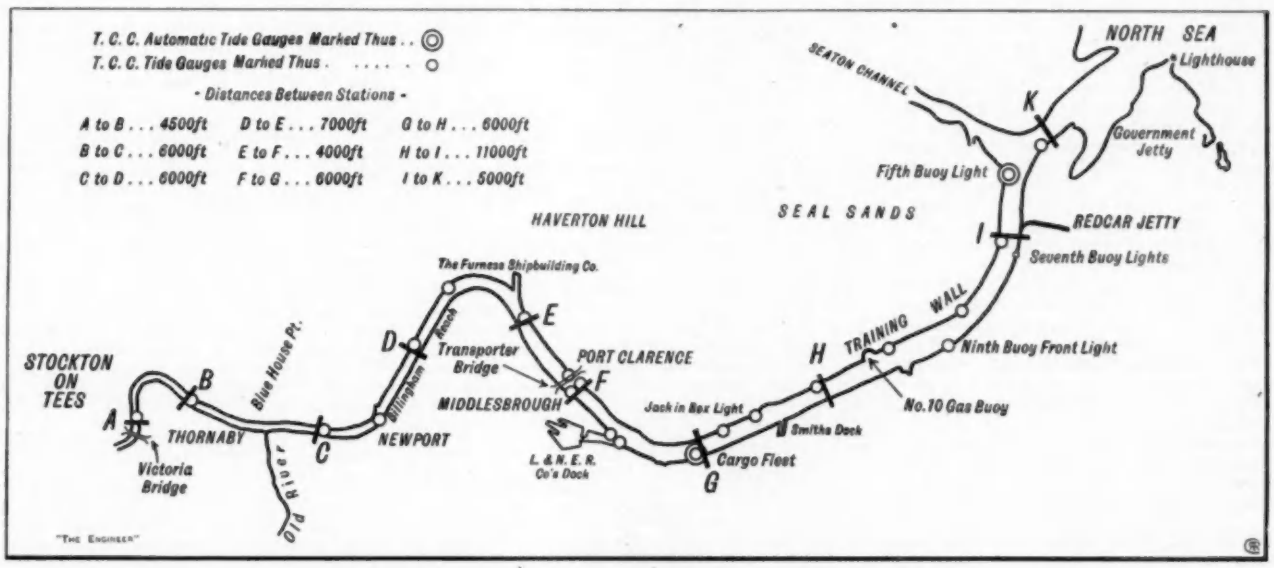
(2) Normal winter level = 1ft. 9in., the corresponding discharge of fresh water being at the rate of 287 million gallons per twenty-four hours.

(3) High winter level = 2ft. 6in., the corresponding discharge of fresh water being at the rate of 523 million gallons per twenty-four hours.

Observations have shown that, under normal winter conditions, the water only occasionally rises above 2ft. 6in. on the gauge, and that any discharge higher than at the rate of 523 million gallons per twenty-four hours is exceptional, so that the Board decided that it is doubtful whether any useful results could be obtained by attempting to estimate the discharge of the river in high floods which only last for a few hours.

Current Measurements in the Tidal Estuary.

As already stated, current measurements were made at ten stations between Stockton and Tees Mouth. They are lettered A to K on the map. In all, observations were made on 126 days spread over a period of seven months. The readings were made, at each station, by means of current meters from boats anchored in the centre of the river, two stations being manned on each occasion. At station F readings were always obtained at the sides of the river as well as in the centre; at the other stations, side readings were obtained when practicable. The strength of the current was measured every half-hour at the surface, and at 1 fathom intervals of depth, the normal period of reading being 2 minutes. River traffic interfered with the work to a certain extent, but at only one position—at the 9th Buoy Light—was it necessary to discontinue observations



HYDROGRAPHICAL SURVEY STATIONS ON THE RIVER TEES

* Obtainable at H.M. Stationery Offices, price 5s. 6d. net.

river, running over an even bed, it has been found that the average speed of the current over the whole cross-section is 0·8 times that of the average speed on the centre line. In the table mentioned, the figures indicate that that factor is, also, approximately true for the tidal estuary. Attention is drawn in the Report to the fact that the factor decreases as the range of tide increases, and that it is smallest at one hour after high water. That, it is remarked, may be due to the fact that the ebb begins to run down the centre of the river on the surface, while the deeper water is still slack. In the Table, the factor is seen to vary from 0·7 to 0·9, but for calculating the volumes of water passing each station, it was considered sufficiently accurate, for the purposes of the Report, to use a factor of 0·8 throughout. The calculated flows at the various stations are given in Tables.

The Report then proceeds to discuss, in succession, "The Upper River at Winter Level," "The Upper River in Flood," "The Movement of Water Towards the Sea," "Water Levels and Times of High and Low Water in the Estuary," and "Deposition of Silt in the River," all of which sections contain most interesting information.

Conclusion.

The Report points out that the most important fact brought out by the hydrographical survey of the Tees is that, at some points, there are considerable differences between the surface and deeper waters, and that, at certain times, the flood is running upstream below the surface while the ebb is still running on the surface. This phenomenon is due to the difference of density between fresh and salt water and would not occur if the North Sea were fresh. "If we imagine for a moment," says the Report, "that there are no tides, that the estuary is separated from the sea by a sluice gate, and that it is full of fresh water, then it is easy to see that if the gate were removed the fresh water would spread out over the surface of the sea and the heavy salt water would force its way upstream along the bottom in a wedge gradually thinning out to nothing. The river water running seaward over the heavy bottom water would continually pick some of the latter by turbulent mixing and carry it away with it, and the salt water so removed would be continuously replaced from the sea. Thus, the surface current would set up a bottom current in the opposite direction, the speed of which would increase as the surface speed increased, until the latter became so great as to sweep all sea water out of the estuary. If, now, tidal action were added, the two currents would flow as before, and, at the same time, the whole system would oscillate up and down the estuary. The observations have shown that this is what actually happens, with the difference that the maximum speed of the flood is at 1 or 2 fathoms below the surface, and not on the bottom. The bottom layers are considerably retarded by friction against the bed of the river. *The conclusion may be drawn that polluting matter cannot escape seawards easily, unless it is in the surface layer. This is of importance when considering the discharge of effluents.*"

The italics are ours. The Report also states that the experience of the survey has shown that the method of measurement of currents by means of floats is *not* suitable for a tidal estuary, where the water is divided into layers and a float might take many days to reach the sea, even if it were not caught up in an eddy. The Board, therefore, recommends that, in future surveys of an estuary, attention should be directed to obtaining accurate measurements of the upper layer.

The Report, which is accompanied by eight tables, a map of the tidal section of the River Tees, four graph diagrams, and forty-six plates, contains a very large amount of interesting and valuable matter, and will, doubtless, be widely studied.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

ROCKETS AND THE UPPER ATMOSPHERE.

Sir,—In *The Times* for August 25th last an article by Dr. Lyon appeared, in which he announced his intention of firing a rocket to a height of 50 miles, for scientific purposes.

The question arises as to whether there is not a serious risk attached to the experiment, which, though it may be remote, is one that is highly undesirable to run.

Sir James Jeans, in his book "The Dynamical Theory of Gases," states that "the proportion of a light gas, however rare at the bottom, must necessarily exceed that of all heavier gases after a sufficient height," and that consequently at remote altitudes there is a large quantity of hydrogen. Without a suitable amount of oxygen, it would not burn, but it is most likely that there is an explosive belt, which the rocket would set on fire in its passage.

The effect *might* merely be an unprecedented display of the nature of an aurora. On the other hand, the heat generated might be so great as to bring about the end of the world, so far as we are concerned. There is a risk of wiping everybody out, except perhaps those of us who were in the Tube, together with such miners as were at work. The latter would probably be trapped underground; the Tube travellers might be able to come up by the stairs, or in the places where the lines come to the surface; perhaps only to find that everything fit to eat had been reduced to ashes!

If we escaped being burnt, owing to the blanketing effect of the intervening air, there is the wave of compression to be reckoned with, which would probably flatten everything on earth to a pancake, including ourselves.

The objection may be raised, that if such a catastrophe were possible, it would have been produced long ago by meteoric agency. The reply is that meteors derive their heat from the friction of the atmosphere, which is negligible at very great heights, and that they only become incandescent after reaching lower levels, well beyond the danger zone.

Sir James Jeans estimates the proportions of the constituent gases at different heights thus:—At ground level the proportion of hydrogen to oxygen molecules in a given volume of air is 1 to 21,000; at a height of 12½ miles it is 1 to 875; and at 50 miles, about 17 to 1. Let us make an estimate of the order of the volume of explosive gas which might be involved. If we assume that the mixture is only inflammable between 25 and 30 miles, the volume is 47,666 cubic miles; of course, at a very low pressure, the mean being 0·035 lb. per square inch, or one 420th part of an atmosphere. The equivalent at ground level pressure would be 113½ cubic miles—enough for a good explosion.

Before any further steps are allowed to be taken, it would be interesting to know whether the possibilities outlined here have been considered, and, if so, on what grounds it has been decided to ignore them.

A pamphlet of mine was published by the Government directly after the war under the title of "Notes on the Variation of Atmospheric Conditions with Altitude," and can be obtained by anyone interested who would like further details in a handy form from H.M. Stationery Office for the modest sum of 6d.

C. F. Dendy Marshall.

October 6th.

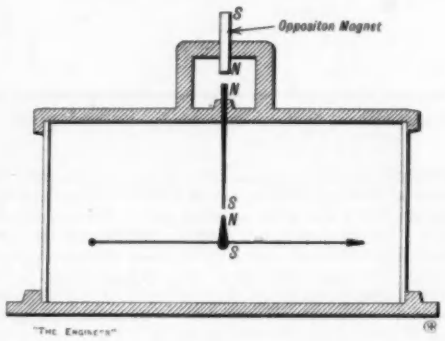
A FRICTIONLESS UNLOCK.

Sir,—In your issue of September 18th Mr. H. R. Kempe describes an ingenious frictionless "unlock," in which he uses magnetic lines to support his trigger.

His claim that this arrangement is absolutely frictionless needs, I think, a little qualification, as it is obvious that as the repulsive lines are called upon to support the member A, the weight of the member A is still borne by the pivot of the member B. It is true, however, that the sliding friction at the point of engagement is eliminated.

The arrangement reminds me of a suspension for an instrument needle, which was devised by the late Mr. C. E. Benham, who demonstrated it to the writer shortly before his death.

On the sketch enclosed, it will be noted that the finger,



which was, as a matter of fact, used for delicate electrostatic measurements, was suspended from a magnetised needle and a neutralising or opposition magnet brought to bear upon the upper pole until such time as the field of the needle was weakened to such an extent as almost to let the finger drop.

By carefully grinding the points of suspension, it was possible to obtain absolutely frictionless support, and the presence of the lines of force in the needle in no wise affected the torque of the finger, as they had no radius.

In the case of Mr. Kempe's unlock, unless it is carefully arranged, the lines of force might tend to operate or to resist the operation of the device.

R. Stanley Lewis, M.I. Mech. E.

October 6th.

The Quarter's Shipbuilding Returns.

From the statistics issued by Lloyd's Register of shipping regarding vessels under construction at the end of September, we note that in Great Britain and Ireland there was a decrease of 138,218 tons in the work in hand as compared with the figures for last June, and that the total —417,385 tons—was 699,361 tons less than the tonnage which was being built at the end of September, 1930. Moreover, the figure for September, 1931, included about 64,000 tons on which work had been suspended. The present total is the lowest recorded since September, 1887. Over 96,000 tons of the tonnage now in hand in this country are intended for registration abroad or for sale.

The tonnage now under construction abroad—1,113,735 tons—is about 157,000 tons less than the work which was in hand at the end of June, 1931. The six leading countries abroad are: United States of America, 261,364 tons; France, 169,720 tons; Italy, 159,147 tons; Sweden, 121,080 tons; Germany, 113,468 tons, and Holland, 95,216 tons. The total reduction, as compared with September, 1930, which took place in the aggregate tonnage being built in those six countries amounted to only 17½ per cent., as compared with a reduction of 62½ per cent. for Great Britain and Ireland. The total tonnage under construction in the world amounts to 1,531,120 tons, of which 27½ per cent. is being built in Great Britain and Ireland, and 72½ per cent. abroad. The average percentages in the last twelve months before the war were 57·2 for Great Britain and Ireland and 42·8 for abroad.

In Great Britain and Ireland, 38,675 tons were begun during the last three months, an increase of 15,316 tons on the corresponding figures for the June quarter. For the purpose of comparison it may be stated that during the six months ended March, 1930, the monthly average of tonnage begun was over 154,000 tons. During the third quarter of 1931, 80,340 tons were launched—a decrease of about 90,000 tons as compared with the quarter ended June 30th last. Similar figures for abroad are 134,685 tons begun, and 306,268 tons launched, showing a decrease, as compared with the previous quarter, of 76,394 tons in the tonnage begun, but the slight increase of 4000 tons in the tonnage launched.

The oil tankers under construction in the world number 64 vessels of 505,258 tons, of which 16 vessels of 122,408 tons are being built in Great Britain and Ireland, 14 vessels of 107,450 tons in Sweden, and 8 of 81,590 tons in Germany. It is noteworthy that of the 64 tankers under construction, 59 are motorships. The tanker tonnage now in hand represents 33 per cent. of the total steam and motor tonnage being built in the world.

During the first three quarters of 1930, the tonnage of motorships under construction in Great Britain and Ireland exceeded that of steamers being built, but since the end of last December, steam tonnage has again exceeded motorship tonnage, the excess at the end of September, 1931, amounting to over 91,000 tons. The motorship tonnage being constructed abroad—613,710 tons—is 115,114 tons greater than that of the steamers.

Of the vessels being built in the world at the end of September, there were 6 steamers of between 8000 and 15,000 tons, while the motorships amounted to 45. Of the larger vessels, *i.e.*, those of 15,000 tons and upwards, however, 7 were steamers of between 15,000 and 30,000 tons, and 6 were steamers of 30,000 tons and upwards, while there were only 4 motorships in the former division, and none in the latter.

The table respecting marine engines shows that the horse-power of steam engines now being built or being fitted on board amounts to about 1,086,000 horse-power, while the figures for oil engines aggregate about 619,000 horse-power. The figures for steam engines include 35 sets of turbine engines of about 978,000 shaft horse-power, giving an average of nearly 28,000 horse-power per set. The horse-power of the steam reciprocating engines—107,985 horse-power—is only 6¼ per cent. of the total horse-power of marine engines now being built in the world.

SIXTY YEARS AGO.

We are by no means certain to-day about the true nature of electricity, but sixty years ago there were some people who were quite dogmatic on the subject. In September, 1871, we published a review of Culley's "Handbook of Practical Telegraphy," and in the course of his notice our reviewer called in question the statement that electricity "is now considered a peculiar force affecting the particles of matter." That statement, he asserted, was impossible of proof, and was open to refutation. A lively and entertaining correspondence ensued upon the subject. Mr. W. H. (Sir William) Preece began it by entering the lists against our reviewer, and in defence of Mr. Culley. Mr. Preece contended that electricity was a force just as gravity and magnetism were forces, and argued that that view of the subject had the support of Helmholtz, Thomson, and other masters. If electricity was not a force, neither, said Mr. Preece, was gravity. Our reviewer was not backward in his reply. He quoted numerous authoritative pronouncements to show that many people had grave doubts as to whether electricity really was a force. He refuted the suggestion that if he denied that electricity was a force, he would logically have to admit that it was matter. It might be neither matter nor force and yet have existence. Mr. Desmond FitzGerald also took part in the discussion. He seems to have been quite undecided on the subject. He had, he said, had to combat the idea that electricity itself was, like heat, a mode of energy. Nevertheless, he added, the proposition that electricity like gravity was simply an attraction almost carried with it its own disproof. Our reviewer appears to have had a glimmering of the truth, for he argued that the question would never be resolved until we had agreed upon definitions for the terms matter, force, energy and electricity. He referred his critics to an able article on "The Abuse of Dynamical Terms," which we had published in January, 1868, and gave instances of confusion arising from the faulty use of the word "force." Faraday, for instance, had used the expression "conservation of forces" when he should certainly have said "conservation of energy." Clearly, our reviewer was strongly inclined to hold the view that electricity is a form of energy, but, at the back of his mind, he had, we infer, some room for the possibility that it might be a form of matter. If he were alive to-day, he would, no doubt, be intensely interested in modern views on the subject. We may, however, doubt whether, as a Victorian believer in the mechanical structure of the Universe, he would find any satisfaction in the current doctrine, which reduces matter to electricity, electricity to energy, and energy to the constant of integration in a differential equation.

Railway and Road Matters.

A special committee is to be appointed to examine and report upon the whole organisation of the railways of India. This is being done as a consequence of the recommendation of an earlier committee, appointed by the Government of India to find out sources of retrenchment.

The death, on the 5th instant, is announced of Mr. Matthew Stirling, the son of Patrick Stirling, of the Great Northern, and nephew of James Stirling, of the South-Eastern. He was under his father until he went to the Hull and Barnsley in 1885, and remained with that company until it was absorbed by the North-Eastern in 1922.

The Inter-European Time-table and Through-carriage Conference, the headquarters of which are in Berne, is being held in London this week. It is being attended by 244 delegates, who represent thirty countries and one hundred government departments, railway and shipping administrations. The Conference meets each October and discusses the time-tables and through coaches for the international services for the following summer.

Tank wagons for conveying milk by railway and similar wagons for its conveyance by road throughout are now an established institution. The latest development therein is a special railway truck to enable the road wagon to travel part of the journey by rail; the present purely railway tank wagon has to be filled at the originating station and emptied at destination. This new truck has been introduced by the Southern Railway and it is loaded and unloaded end-on by means of a wire rope. The truck is fitted with the vacuum brake and has steam-heat pipes.

The Bengal and North-Western Railway and the Rohilkund and Kumaon should be acquired by the Government of India at the end of 1932. It means, however, the raising of £12,000,000, which, in view of the present financial position and the state of trade, is not, in the eyes of the State, considered desirable just now. If the purchase is not made the option must wait for another fifty years, and so a committee which has been considering the matter recommends that an agreement be entered into to purchase the lines at any time up to December 31st, 1937, subject to twelve months' intimation.

Mention in this column of the City of Dublin Steam Packet Company can be justified because it had an interest in a railway—the City of Dublin Junction, which connected the Dublin and South-Eastern with the Great Northern and so allowed for the transit of the mails off its steamers by rail throughout from and to Kingstown. The City of Dublin Company carried the mails between Kingstown and Holyhead until national sentiment could support it no longer against the lower tender of the London and North-Western Railway, and soon after the contract went to the railway company the City of Dublin Company ceased business. Throughout the whole of its one hundred years of existence it never lost the life of a passenger until the "Leinster" was sunk, with 500 souls on board, by a torpedo a month before the Armistice.

After the reorganisation of the administration of the New Zealand Government Railways come proposals for a reform in the administration governing the railways of South Australia, where there is only a single railway commissioner at the head. It is suggested that there should be a board, with a managing director and five other directors; the board to be responsible to Parliament. The present commissioner would be the managing director for the balance of the term of his present appointment. The Royal Commission which has been investigating this question also recommends the establishment of a Ministry of Transport to co-ordinate all transport activities, and lays stress on the need for the Railways Department conforming to a definite financial task and taking full responsibility for deficits. The present practice of permitting the railways to depend on Parliament to find the funds to meet huge deficits in recent years is condemned as demoralising.

The annual report by Colonel Mount on the accidents of last year shows that of the 204 fatal accidents to servants engaged in the movement of trains and vehicles, other than in train accidents, 63·2 per cent. were caused by want of caution or misconduct of the servant concerned and 34 per cent. were accidental or due to misadventure. Of the 2035 non-fatal "movement" accidents, 71·23 per cent. were the result of accident or misadventure, and 18·69 per cent. to want of caution or misconduct. There were 53 men killed and 42 injured whilst working on the permanent way. The injured numbered much less than those in 1929 and than the average for 1925–1929, but the 53 killed compared with 52 in 1929 and an average of 51 for 1925–1929. Of the total of 95 accidents during 1930, there were 31 due to the want of individual care in crossing lines, &c.; in 26 cases the protection of the men when at work was inadequate, as no look-out man was provided; in 19 instances the men concerned failed to act upon the warning they had received; and in 11 the look-out man himself was at fault or personally careless.

The carrying forward of the London Passenger Transport Bill, in its present state, to the new Parliament was not achieved without difficulty. That step was unanimously approved, as related in our Seven-day Journal last week, in the House of Commons, but was strongly questioned in the House of Lords, which was concerned in the matter, as the Bill was considered by a Joint Select Committee of both Houses. The Earl of Onslow, Chairman of Committees, said that, strictly speaking, the Bill was a public measure, but in its operation it was far more analagous to a private Bill. If it were carried over such a step should be regarded as exceptional and not be taken as a precedent. The Earl of Crawford considered that the Bill was very contentious, and raised large questions of public policy, and the resolution meant that the next Parliament would be deprived of its inherent right to consider every stage of the Bill. Earl Peel, the Lord Privy Seal, remarked that if the Bill were not carried forward the Exchequer would be at a loss of between £30,000 and £40,000. Lord Sankey, the Lord Chancellor, was, however, able to persuade the House to accept the motion on Wednesday, October 7th. He admitted that the step was unprecedented, but the country was living in unprecedented times.

Notes and Memoranda.

For the purpose of a high-level railway crossing in Toledo, Ohio, some plate girders of 154ft. span were put in place in one operation. They are 12ft. 1in. deep and each weighs 168,000 lb. They were brought to the site by rail and were put in place by two 60-ton cranes, one 40-ton crane and a derrick in less than one hour by ten men and a foreman.

According to a periodical published by the Prussian Ministry for Commerce and Trade, the following numbers of accidents due to shot-firing have occurred in Germany since 1926 per 1000 tons of explosives used:—In 1926 the total number of accidents was 16·6, of which 1·6 were fatal; in 1927, 15·4, 2·3; in 1928, 15·0, 1·6; in 1929, 9·7, 0·8; in 1930, 8·9, 0·7. Many of the accidents, the publication states, could have been avoided by paying more attention to "safety first" precautions.

The interruption of a circuit in a plain break circuit breaker depends upon the drawing of an arc, which, owing to inherent magnetic blow-out or accidental turbulence of the oil, will ultimately be broken up at the current zero by partitions of solid oil thick enough to withstand puncture by the recovery voltage across the circuit breaker terminals. This procedure can be replaced by a positive and definite oil blast action by enclosing the two breaks in such a way that pressure from the gas bubble at one break will propel a blast of solid oil across the second break. Tests reported in the *Electrical World* show that for 13,000 to 15,000-V switches with an interrupting capacity of 175,000 kVA, the maximum arc duration is reduced from 7·75 to 1·75 cycles and the arc length from 3·5in. to 1·5in.

The largest and most completely equipped establishment in the world for research on wood is to be constructed at Madison, Wis., at the new building for the U.S. Forest Products Laboratory. The building, to be completed in one year, will be U-shaped, about 275ft. in length, and of fire-proof construction throughout. It will have six storeys, with a total floor space of 175,000 square feet. The pulp and paper research laboratory, occupying six floors at one end of the building, will include grinder equipment, a digester tower 40ft. square, beating and refining apparatus, and an experimental paper machine with all moving parts under precision control. Provision is made for a large timber preservation laboratory, a wood-fermentation unit, fractionating stills, a general section of wood chemistry, wood gluing, painting, finishing, and fireproofing laboratories, and facilities for the study of wood fungi and insect pests, and the abatement of their damages.

A year ago, states the *Electrical World*, it took a crew of eight men twelve hours to tramp over a 35-mile section of transmission line right of way to patrol the lines of the Northern New York Utilities Company. To-day an aeroplane saves many weary hours of walking, and expedites the work. It flies at a speed of from 80 to 100 miles per hour about 50ft. to 100ft. one side of the right of way and about 100ft. to 200ft. above the ground. Even at this speed there is time to observe failures, but the observer must know the tower numbers and be familiar with the maps of lines over which the aeroplane is flown. Observations are transmitted by dropping notes at the nearest sub-station or by telephone when the aeroplane lands. The first air patrol of these lines was made in June, 1929, when a severe electrical storm had put important lines out of service. The entire construction crew had to leave various duties to patrol the seven 110,000-volt lines. An aeroplane observer flew over each line twice, covering 300 miles in six hours, and was able to discover every flash-over reported by the ground men, as well as an additional shattered unit.

For some years the Mutual Telephone Company, Honolulu, has studied the possibilities of inter-connecting the various islands telephonically. Rough seas and depth of water do not favour cable laying, while radio-telephony with medium and short waves, 1500 kc. and 5000 kc., is not satisfactory, owing to selective fading and strong atmospherics, the cost of overcoming which defects the company could not afford. Tests having been successful, it has now been decided to provide an ultra-short-wave service. With Oahu as the centre, there will be a two-way service between that island and Maui, Kauai, and Hawaii, also between Hawaii and Maui, to begin with; and later on additional services will be provided between Oahu and Maui and between Oahu and Hawaii, also between Oahu and the islands of Lanai and Molokai. The frequencies will range from 35,200 kc. to 54,000 kc. These circuits, together with the facilities now being provided in Hawaii to connect the Mutual Telephone Company with the telephone system in San Francisco, will soon link the important islands of Hawaii with many countries through the world-wide telephone system of the American Telephone and Telegraph Company.

According to the *Chemical Trade Journal*, comprehensive research on the fire-proofing of timber by means of surface coatings of soluble silicate has been carried out by two Russian investigators, Messrs. E. Kostyrko and P. Pshenitzyn. They find that the best results are obtained with a mixture of equal parts of soda and potash soluble glass. To a 30 deg. Bé. solution of this mixture, 25 to 50 per cent. of its weight of solid fillers consisting of one or more of the following materials are added:—Baked clay, tripoli, finely ground French chalk, sand or ground siliceous rock. The total amount of soluble glass used should be 3 per cent. of the solids, the amount of amorphous silica in the soluble glass to be taken into consideration in this calculation. The addition of 5 to 10 per cent. of the oxides of iron, aluminium, lead, calcium, magnesium or zinc increases the solidity of the coating and its resistance to water. The paste is applied in two or three layers with a brush, and after four to seven days should give a coating sufficiently fire and water resisting. To obtain coloured coatings, the further addition is made of 5 to 20 per cent. of such pigments as iron oxide, chrome green, ochre, ultramarine or manganese black. The use of mixtures of sodium and potassium silicate is to strike a balance between the permanence of the coating and its fire-resisting properties.

Miscellanea.

According to a report from Stockholm there has been a big increase in laid-up Swedish tonnage. On September 1st the number of vessels out of commission was 70, aggregating 123,521 gross tons; by October 1st these figures had increased to 102 vessels, totalling 162,155 gross tons, covering principally vessels between 500 and 2000 tons.

The Limerick Harbour Board invites tenders by November 7th from engineering contractors for the construction of an extension to the floating dock. The plans include the excavation of about 28,000 cubic yards of earth, and 16,000 of rock, also the provision of 27,000 cubic yards of mass concrete and 650 tons of sheet piling, with dock gates, penstocks and operating gear.

During the voyage of the flying boat "Saro 7" to Port Sudan and back, which was recently completed, an average speed of 92·5 miles per hour was attained, and several non-stop flights of over 1000 miles were made. She is an all-metal military craft, and is fitted with three Bristol Jupiter engines. When arranged for commercial service these machines can accommodate twenty-one passengers.

Sir Richard Gregory, Bart., LL.D., D.Sc., F.R.A.S., will open at 4 p.m. on Wednesday, October 21st, at the Science Museum, South Kensington, an exhibition which will illustrate modern research in the British glass industry. This exhibition is being arranged by the Society of Glass Technology, with the support of the Glass Research Delegacy. The Society of Glass Technology was the first of its kind in the world.

It is reported that the Moscow Soviet is considering a plan for replacing all the existing systems of supplying heat to Moscow by a system of hot water supply, carried in pipes from thermal-electric central stations built in every district of the city. It is estimated that this plan would result in an economy of 1½ million tons of fuel per annum and would lead to an improvement in sanitary conditions and a diminution of the danger from outbreaks of fire.

A new aerodrome and aeroplane-producing centre, which it is hoped will become the largest in Europe and give employment to thousands of British workmen, was recently opened at Ford, near Arundel. During the war it was an R.A.F. depôt. Some months ago, Mr. Henry Ford was seeking a site on the South side of London easily accessible to the Continent, and found an aerodrome already constructed at a place bearing his own name. He decided to buy and rebuild it.

An association is being formed in Oxford with the name of the Oxford Noise Abatement Society. Its objects are palpable, and it is intended that the society shall "co-operate with local authorities in diminishing the unnecessary speed, noise and vibration of motor traffic in our streets." We hope that the society may extend its sphere of action and lose its somewhat parochial character which is at present indicated. The Master of Balliol is sponsoring the movement.

The largest amount given by the Royal Commission on Awards to Inventors in the period covered by its sixth report, which was recently issued, is £100,000 awarded to Peter Brotherhood, Ltd., for improvements in internal combustion engines. The sum is described as a further recommendation. Sir James Blacklock Henderson, who invented many improvements in naval gunnery, is given £5000 for liquid level control in gyro compasses, and £1000 for floating ballistic and modified ballistic.

Speaking at the Institution of Structural Engineers last week, Dr. E. Probst, of Karlsruhe, said: "There exists a critical stress for concrete in compression and tension. Loadings below that stress strengthen the material and render it elastic. For that reason it is advisable to provide for a critical limit, as high as possible, in the case of structures subjected to high alternate stresses. That means a material of great strength and elasticity. Alternating loadings below the critical strains and stresses do not influence the load of rupture."

The returns of iron and steel production in France, issued by the Comité des Forges, show that there was a further notable decline during August, the total quantity of pig iron being 682,000 tons, as compared with 845,000 tons in August of last year. The number of furnaces in blast was 113, instead of 143. The production of steel was 645,000 tons, as against 775,000 tons. There was a decline all round in rolled iron and steel. Rails fell from 53,000 tons to 23,000 tons, bars from 203,000 tons to 183,000 tons, and sheets and plates from 92,000 to 78,000 tons.

The official returns rendered to the Electricity Commissioners show that 875 million units of electricity were generated by authorised undertakers in Great Britain during the month of September, 1931, as compared with the finally revised figure of 834 million units in the corresponding month of 1930, or an increase of 4·9 per cent. During the first nine months of 1931 up to the end of September, the total amount of electricity generated by authorised undertakers was 8048 million units, as compared with the finally revised figure of 7762 million units for the corresponding period of 1930, representing an increase of 3·6 per cent.

The monthly report of the National Federation of Iron and Steel Manufacturers shows that the number of furnaces in operation at the end of September was sixty-two, a net decrease of two since the beginning of the month, four furnaces having ceased operations and two furnaces having been blown in. The production of pig iron amounted to 248,200 tons, compared with 275,700 tons in August, and 425,000 tons in September, 1930. The production includes: 29,300 tons of hematite, 107,400 tons of basic, 89,100 tons of foundry, and 12,800 tons of forge pig iron. The September output of steel ingots and castings amounted to 400,500 tons, compared with 357,300 tons in August and 580,600 tons in September, 1930.

EXHIBITS AT THE OLYMPIA MOTOR CAR SHOW

(*For description see page 400*)

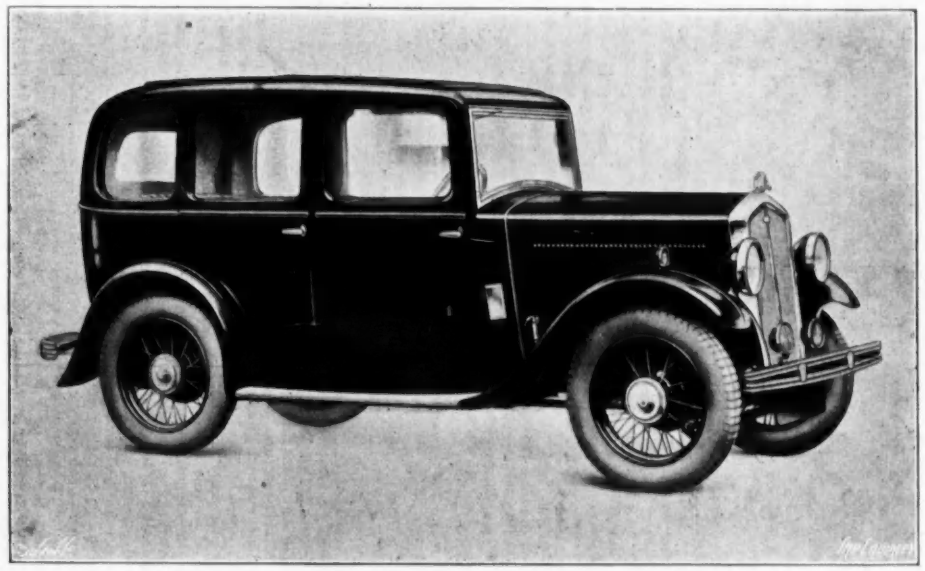


FIG. 6—"HORNET" FOUR-DOOR SALOON—WOLSELEY

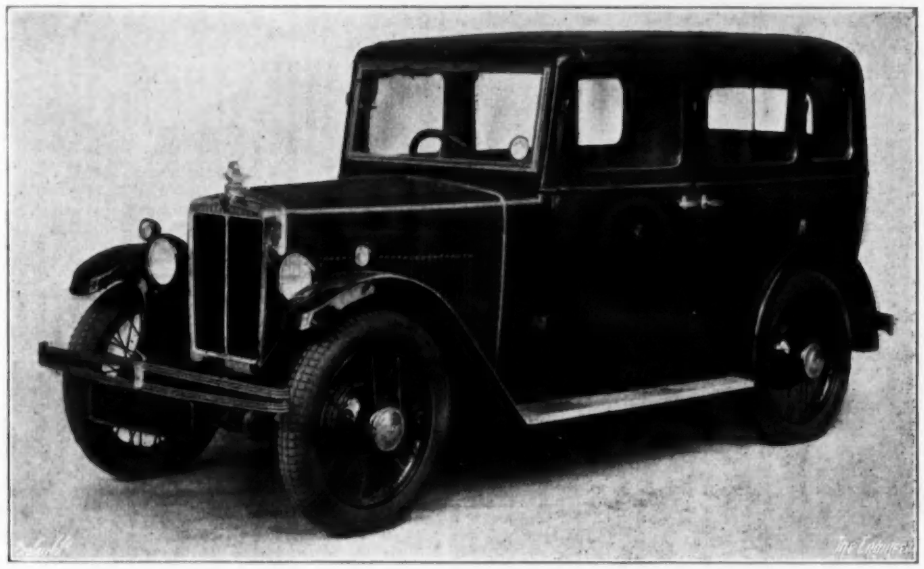


FIG. 7—"FAMILY EIGHT" SALOON—MORRIS

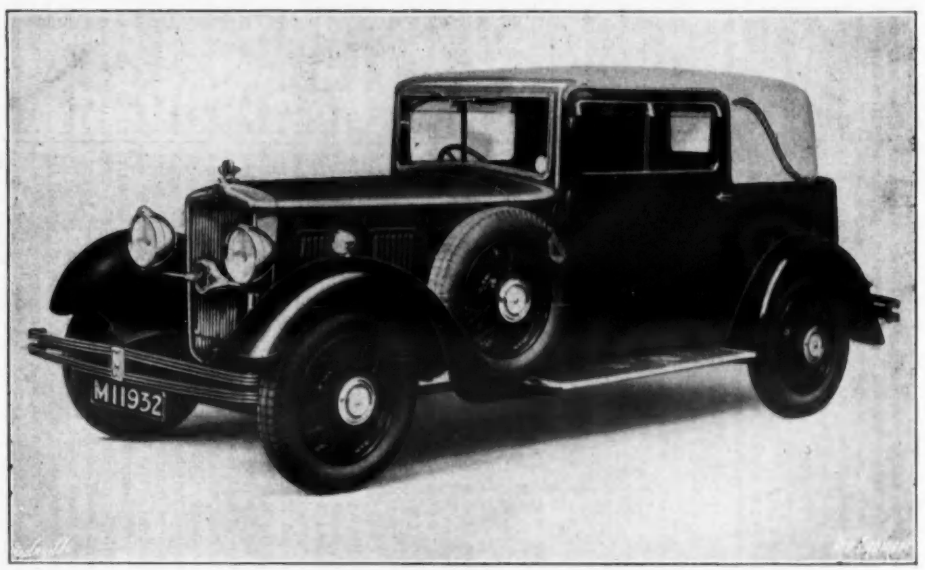


FIG. 8—"ISIS SIX" SPORTS COUPE—MORRIS

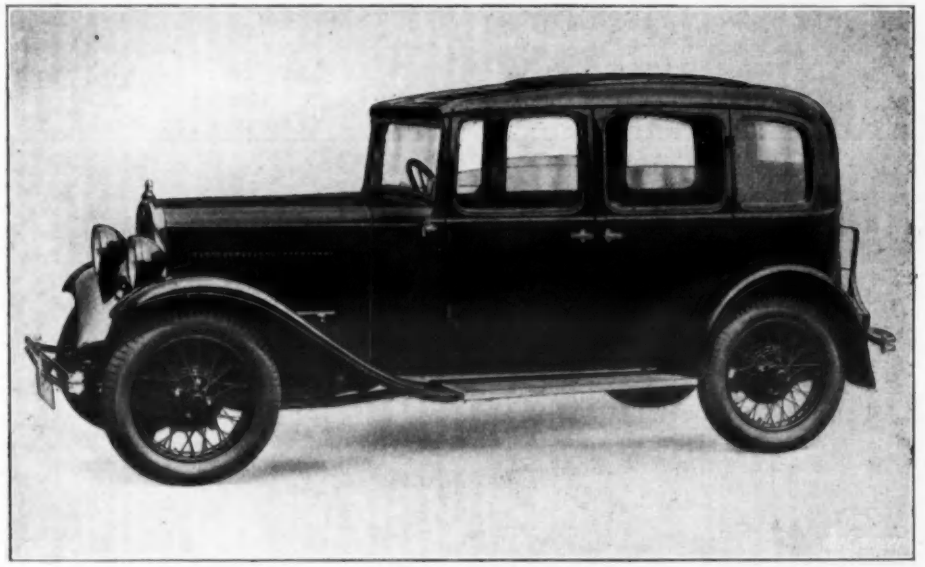


FIG. 9—"TWELVE-SIX" SALOON—AUSTIN

The Engineer

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ERRATUM.

38 B.H.P. HIGH-SPEED HEAVY-OIL ENGINE.—Owing to an unfortunate slip, the high-speed heavy-oil engine illustrated by Fig. 137 on page 380 in our issue of October 9th, 1931, was ascribed to "Ruston-Lister." The illustration shows, in fact, the engine built by John Fowler and Co. (Leeds), Ltd., and described and illustrated by a drawing on page 374.

THE ENGINEER.

VOL. CLII. No. 3953

OCTOBER 16, 1931.

Welding and the Welder.

IF a distinction may be drawn between almost similar qualities, it may be said that the aim of technology has always been to bring about the reduction of skill and the increase of dexterity. The turner who, in days gone by, produced a good thread by hand chasing, exercised dexterity; but he who chased a bolt and a nut to fit each other was a skilful workman. In the making of the parts of electric lamps much dexterity is called for, but the development of machines and appliances has almost removed from the process the element of skill. The mass production of motor cars or sewing machines necessitates the command of great dexterity in the handling of specialised tools or equipment, but the skill is reserved for the artisan who produces the appliances—gauges, dies, &c.—used subsequently by the workpeople. Fine caligraphy calls for skill; but the typewriter for dexterity only. The distinction is not a merely idle one. The inventor may produce methods, processes and machines for achieving certain purposes; but until dexterity alone suffices for the use of those methods, processes and machines, they fall short of their ultimate usefulness. Welding provides an example of growing importance. Applied science has given us the fusion weld, but it has not yet given us the means of doing trustworthy work by mere dexterity. We dare not say "there is a welding equipment and a welding rod; run a seam with it and it will be good." That cannot yet be done; skill acquired by many years' experience is still required. A good welder cannot be made in a dozen lessons, as girl-turners were made during the war. No doubt that will come in time and welding will be as simple an affair as soldering cocoa tins.

Whenever the question of fusion welding is discussed amongst engineers, the importance of the human factor is always insisted upon. It is recognised that the strength of the weld is proportionate to the skill of the welder. As long as that is so, some doubt about the safety of the work will always remain. The goodness of a weld cannot be seen by inspection; there is no easy test of its quality. A putty rivet may be scratched with the thumb nail and a loose one found with the hammer; but a bad weld is hidden from the eye or touch. The human element enters into its constitution. The only way—at present—of making sure of good welds is to make sure of good welders. In the recently issued report of the American Bureau of Welding it is shown that the work done by a gang of welders with an average experience of eight years was about 10 per cent. better than that of men with an average of three and a-half years' experience. The best men out of an approved group of thirty-four welders was over 20 per cent. better than that of the worst operator. Such facts as these give support to the view of those who stress the human factor in welding. The American Bureau, whose report is the outcome of five years' work, recognised that no safe deductions could be made until the influence of skill could be removed, and it took great pains to ensure that a certain measure of proficiency had been attained by all those who made specimens—misnamed "coupons" in the American jargon—for the ultimate tests. A great part of the report is given up to the examination of qualification tests. One of them is of a very simple nature and is held to be "rapid, inexpensive and excellent for examining the weld metal and the degree of penetration." Two strips of plate are welded at their overlap with a fillet. A wedge is then driven in between the plates at the unwelded end to force them apart until the weld ruptures. A crude test, perhaps; a test without measurements; an unscientific test, but, nevertheless, as a rapid and easy way of finding out the quality of the work not to be sneered at. Moreover, there was a tensile test as well. Out of the thirty-four men who were selected to make specimens for the programme tests, twenty-six fell in the first class, and the committee considers the results attained by them to be a fair indication of what may be expected in commercial structural practice. Their "programme performance" reflected their qualification tests. From this the conclusion is reached that in structural welding practice an average of 52 kips per square inch and a minimum of 45 kips per square inch may be expected. ("Kips" is another new American term; it means thousands of pounds. With the tones of Mr. Baldwin's protest at Sebright School on Saturday last still ringing in our ears, we do not perpetuate it willingly.) If the welder has reached the standard of qualification indicated by these figures, the Committee concludes that "a welded joint may be expected to have a strength within 12 per cent. of a general average for the type of joint." In other words, even with all reasonable care in the selection of craftsmen, a considerable variation in the strength of structural welds is, as yet, unavoidable.

We need offer no apology for stressing this particular part of a very instructive report and omitting discussion of the technical issues. As long as welding depends upon skill, the human factor must remain of such moment that technical deductions from tests lose much of their value. It is now agreed, it is quite undeniable in the face of much evidence, that welding may be used successfully even for pressure vessels. But opposition to its employment for that purpose remains just because great skill is essential and the human factor cannot be left out of account. In structural welding, and in fabricated welding, the danger is less, but it still remains the fact that quite considerable variations in strength occur owing to the greater or less skill of the operator. Both cases present a problem to the welding engineer—the invention of means whereby welds can be made up to a given standard of excellence with much less need for reliance upon the skill of the welder than is now necessary. We have no doubt that that object will be attained in time. Just as the pyrometer has taken the place of the eye and experience of the steel worker so we may expect that science will provide the means of ensuring that all fusion welds are good welds and may be used without hesitation even for pressure vessels.

High-Speed Oil Engines.

AN outstanding feature of the recent Shipping, Engineering and Machinery Exhibition at Olympia upon which many engineers commented was the

extraordinary number of high-speed compression-ignition oil engines. Those who did not examine these particular engines will be able to see some of them at the Motor Show, with its recently established marine section, and at the later Commercial Motor Transport Exhibition. The present moment is therefore an appropriate one in which to review the position, to record some of the progress which has been made, and to indicate those problems which have still to be faced in the further development of this important form of small prime mover. A particularly satisfactory feature is the many-sided activity of British oil engine and motor manufacturers in this new field, which is in striking contrast with their attitude a few years ago, when, apart from one or two pioneer firms, little interest was being taken in the small high-speed heavy oil engine by the majority of the then makers of internal combustion engines for road and rail transport. Probably one of the most successful branches of the new industry is that connected with marine propulsion and auxiliary engines, in which sphere many British makers have now attained a leading position.

Up to the present the progress made reveals but little indication of that finality of design which we have come to associate with the petrol engine. The diversity of types is still great. No line of attack has been neglected either by those firms working on their own designs or by others who have collaborated with continental firms. The early success achieved with the direct injection engines with piston swirl has led to very satisfactory results being obtained on land and sea. Most of the engines falling into this class use the four stroke cycle, but others have employed the opposed piston principle and port swirl with noteworthy success. Another class of engine which has perhaps found, up to the present, greater favour on the Continent than in this country is that employing an ante-chamber, in which the combustion of a small fraction of the fuel is used to promote turbulence and good combustion in the main cylinder. Such engines have given a good account of themselves in both commercial lorries and rail cars, and work on them is being continued both here and abroad. A further class which has been widely constructed is that which employs an auxiliary air chamber. This engine has been the subject of considerable experimental work, resulting in widely differing dispositions of the chamber. In to-day's issue we publish tests of a new design, in which the use of a hot body in direct conjunction with a combustion chamber designed to give an ordered turbulence has enabled very satisfactory results to be attained at very high speeds. This engine is of Swiss origin, but several British designed engines are now under construction and test. One such engine, that of the A.E.G., which in several respects closely resembles the Swiss engine described in our article referred to above, is to be exhibited at the Commercial Motor Show. The great variety in piston and cylinder head arrangements—equally efficient results are claimed for plain dished pistons as for the more complicated ante-chamber and auxiliary air cells—have for their immediate object the better control of the combustion process and elimination of knock. Very closely connected with the problem of combustion control is the question of the fuel pump and its capacity to deliver those extremely minute quantities of fuel necessary for the smaller sizes of cylinders and higher speeds. Almost without exception the pump now most generally employed to-day is of the single plunger pattern. This pump has achieved its favoured position mainly on account of the high degree of accuracy and the high standard of workmanship of its standardised manufacture, but its delivery characteristic is directly dependent upon the form of an operating cam. The question may well be put whether the time has not now arrived when further progress demands improved injection gear employing entirely new principles. New designs should have as their goal higher efficiencies and greater flexibility at still higher speeds with still smaller cylinders. Help in this direction will undoubtedly be given by the production of new fuels which will cut down the ignition lag and make possible better rates of pressure rise in order to eliminate combustion knock.

Summing up the position, it will be seen that what engineers have to strive for is a high-speed engine of light weight which will be capable of using efficiently a wide range of fuels and will give a performance under service conditions comparable with that of the modern petrol engine. The time may not yet be ripe for the general application of such engines to private motor cars, but the field of road and rail transport is more than ready for such an engine. The exhibition at Olympia of the Super-marine Rolls-Royce S6B machine which won the Schneider Trophy competition is a reminder to engineers of the supremacy of the British high-speed petrol engine which should help to spur engineers towards further successes in high-speed heavy oil engine performance.

Industrial Production in Soviet Russia.

(*From a Correspondent.*)

If it were not for the fact that the present rulers of Soviet Russia have reversed the teaching of the Latin proverb that it is best to make haste slowly, it is possible that in the course of years they would be able to build up great industries; but as matters stand it seems reasonable to assume that the present efforts will not lead to any permanent success. At least this is the opinion formed by an impartial observer after a daily study for some years past of the columns of the Russian official organ of the Commissariats of Foreign Trade and Industry, Railways and Finance. Rightly or wrongly, the conclusion of the writer is that the second five years' industrial plan which begins in 1933 will very probably be a failure; the first quinquennial plan which expires in 1932 has already failed.

Leaving out of consideration the question of the agricultural and allied industries, in which no doubt great progress has been made with the assistance of coercive measures, the whole scheme of Soviet industrial development is based upon the expansion of the coal, iron and steel, and petroleum industries. If it should prove to be impossible to expand the production in these branches to the extent which is considered necessary for the promotion of the other industries, the natural result would be a failure of the general plan of development to a more or less extent.

Take the case of coal and let us see what is the exact position. The main centre of production upon which reliance is placed is the region of the Donetz, which raised 36,185,000 metric tons of coal in the year ended with September, 1930, as compared with 46·6 million tons for the whole of the Soviet Union. During the first six months in the present year the production in the Donetz basin, according to the Moscow *Economic Life*, amounted to 19,013,714 tons, or only 63·8 per cent. of the programme, so that the deficiency for the half year exceeded 10,791,000 tons. The June output was 3,273,000 tons, and it declined to 3,142,000 tons in July and further to 3,107,000 tons in August.

At this rate the total production for the whole year will not very materially surpass that which took place in the year ended with September, 1930. As the reasons for the insignificant progress are mentioned, the absence of discipline among the miners and the many desertions, the latter of which are largely due to the unfavourable conditions of working in the pits and the unfavourable "housing" accommodation and the food supply. However, new mines are being opened up which are expected to result in an increase in the production; but it is impossible to say where the necessary labour will be obtained for the new pits, as there is already a shortage of men at those already in operation. Another matter which detrimentally affects the production, which is now said to be machine mined to the extent of about 60 per cent., the difficulty in getting repairs carried out owing to the absence or scarcity of spare parts.

Iron and Steel Scarcity.

Matters are not much better in the iron and steel industry. According to the same Moscow authority, the production of pig iron, which this year was to be increased to 8,000,000 tons, amounted only to 2,350,000 tons in the six months ended with June; that of steel was 2,609,000 tons and that of rolled products was 1,917,000 tons, or 61·7 per cent., 61 per cent., and 53·6 per cent. of the programme in the three cases respectively. On this basis the total for the complete year will not be much better than that for 1930. The tight place in the operation of the blast-furnaces is said to lie in the mixing of the charges, which are badly prepared and thus affect the working of the furnaces. As recently as August 18th it was reported by the Moscow newspaper that the furnaces were being fed with "rubbish." In the preparation of the charges complete impersonalisation prevails; no one is responsible for the mixing of the different grades of ore and coke; the quality of the coke is inferior, while at the same time there is a shortage of 12,000 men at the existing blast-furnaces and iron and steel works. However, according to Soviet official statements and sketches published in the newspapers, enormous new iron and steel works are being erected at Magnitogorsk and in the Kusenetz basin, which will, it is claimed, surpass in output capacity those in any other part of the world.

The only other of the three raw material industries mentioned which appears to be making distinct progress is that of the winning of petroleum. But even this development is greatly behind the plan. For the eight months ended with August the output of crude oil is recorded as having reached 15·5 million tons, or 87·7 per cent. of the programme and 26·3 per cent. more than in the corresponding period of last year. But the lack of intensity in the work of exploration of new sources renders it doubtful whether, even next year, the output will be brought up to the programme of 28 million tons, to say nothing of the fantastic plan for winning 125 million tons in 1937.

It will thus be seen that on the basis of the Soviet official figures for the three main raw material industries the progress made in the past year or two is far behind the expectations entertained in Soviet official circles as represented by the predetermined programme. It would seem that perhaps with the exception of the petroleum industry the production at the existing coal pits and iron and steel works has almost reached its maximum limit. On the other hand, the working of new pits and the starting of new iron and steel works are held in prospect in the near future, so that this circumstance may or may not bring about a change in the situation, provided that it should be possible to find adequate labour of the requisite kinds. This seems doubtful, however, in view of the shortage at the coal pits and existing iron and steel works. A deficiency exists in the supply of coal to the industrial works already in operation, and the month of September witnessed the inauguration of a great campaign in order to ensure economy in the use of coal in all directions, as it is feared that the situation is so strained that it threatens to undermine the success of the five years' plan, which will end with next year.

Railways and Other Transport Problems.

The railways continue to be in urgent need of rails for new construction and renewals, and of locomotives and other rolling stock. In this connection information to hand of the date of September 3rd shows that the locomotive works delivered 383 locomotives in the first half of this year, as against the planned 448, and a further 123 instead of 285 in July and August. In the case of goods wagons 6666 were supplied in the six months, as compared with the 11,530 which were contemplated, while down to August 20th the number of wagons supplied was 1200 out of the number of 11,800 called for in the quarter ended with September.

A state of confusion is reported to exist at the ports of Leningrad and in the Black Sea through the lack of responsibility and the absence of adequate mechanical equipment, while the construction of ships for the large inland waterways is proceeding at a very slow rate, having regard to the demands which are now being made on the waterways for assisting in the transport of the larger tonnage of goods which cannot be handled by the railways alone.

On the question of the manufacture of electrical plant and the construction of sea-going ships the Soviet newspapers for some time past have maintained almost complete silence. In the case of the former industry all recent information about production has been given in Soviet roubles, showing increases over last year, but it is impossible to ascertain the real value of this currency. At the same time reports placed before the Soviet National Commissioners in September complain of the defective construction of turbines at the Leningrad works. The conclusion reached by the Commissioners is that, owing to the insufficient attention paid by the works to the quality of the machines turned out and the unsatisfactory organisation of the technical control, the steam turbines made by these works in a number of cases have proved unsatisfactory, as, for instance, at the Saratoff, Shterovsky, Bisokovsky and Krasnodarsk generating stations, where serious defects have been manifested. Moreover, the Commissioners found that due attention is not devoted to the production of auxiliary equipment for the turbines, in consequence of which the machines are incomplete and the period for erection extends to six and seven months. The Leningrad works are stated to have constructed turbines of up to 12,000 kW capacity and made arrangements for turning out machines up to 24,000 and even 50,000 kW.

With regard to the shipbuilding branch there is practically nothing to record in the absence of quite recent news. But the last reports published on the question again referred to the delay in the carrying out of the programme and the great difficulties experienced in getting supplies of shipbuilding materials and in obtaining oil and other engines and plant for the equipment of the ships themselves.

Lack of Organisation and Responsibility.

Judging from the Soviet's own statements, there is a complete lack of organisation and responsibility in connection with all industries, and it would appear that the attempt to transfer to industrial production the hasty speeding-up tactics which have been applied to agriculture and allied branches has not proved to be successful. There is an absence of effective general and departmental control, and the manner in which the workmen are able to intervene is not conducive to overcoming the state of confusion, which may be said to be of quite a general nature.

Literature.

Official History of the War: Naval Operations. Vols. IV. and V. By Sir HENRY NEWBOLT. London: Longmans, Green and Co. Price, Vol. IV., 21s. net, Vol. V. 31s. 6d. net.

To a maritime people, anything dealing with affairs of the sea will always be of interest, but, to an island race such as our own, whose dominion has been extended, in the racially short space of four centuries, from almost parochial limits to the wide compass of one-quarter of the world, a history of its operations at sea in a war, when the very existence of that dominion was challenged, as it had never previously been challenged, must make the strongest and most vital appeal. In this spirit, the writer began his study of Sir Henry Newbolt's two concluding volumes of the official history of the naval side of the Great War.

These works, commissioned by the historical section of the Committee of Imperial Defence, describe the Empire's operations at sea from June, 1916, to November, 1918, not as might perhaps be expected from the gifted author of "Admirals All" and "The Sailing of the Long Ships," as a tale of human heroism, set with befitting pageantry on the rolling stage of the Seven Seas, but rather as a meticulously detailed account of the enormous series of widely differing operations in which the personalities of the actors are wholly subordinated to a description of their actions and to a judicial evaluation of their achievements.

The volumes contain no fine writing, no apt phrase stimulates the imagination. They are not literature, as their author would understand the term. They are dull, detailed, and in the main depressing, yet to students and professional naval officers the very absence of embellishments will augment their undoubted worth. An artist in words, Sir Henry Newbolt has chosen to tell his tale with the uninspiring precision of a legal document.

While the outbreak of the war found the naval staffs of both belligerent groups harassed by the greatest of all doubts, a complete lack of practical knowledge of the true potentialities of the weapons at their disposal, at the opening of the period covered by these two volumes—Jutland had taken place—our Admiralty was fully acquainted with the technical realities of the situation.

Whether or not our ships were generally inferior to those of the enemy, as they undoubtedly had been during the eighteenth century, requires expert and impartial adjudication, but it is clear that our shells suffered from at least one serious fault, while our ships, as had been so unhappily and conclusively demonstrated at Jutland itself, had very grave defects with regard to magazine protection. Above all, while our Navy, in part as a result of that indeterminate battle, had increased its ascendancy over the enemy's surface fleet, it had singularly failed in its combat with their underwater craft.

The situation was bad and definitely not improving. Strengthened by experience and assisted by technical developments, German submarine commanders passed—almost with impunity—both down the Channel and through the Straits of Gibraltar, to destroy our merchant shipping on seas from which their own had long been banished. The Central Empires, it was true, were slowly feeling the relentless and weakening influences of an effective blockade, but, paradoxically enough, by virtue of the development of underwater craft, they, too were also exercising one. Starvation, the weapon of both sides, was to decide the issue.

The fruits of victory have now long been gathered in, yet the manner in which they were gained is scarcely free from controversy. From the figures of merchant tonnage losses given by Sir Henry Newbolt, it is abundantly clear that during the twelve months following Jutland, the Navy was vigorously and courageously fighting a losing battle. In March, 1918, a British Army suffered a defeat of unprecedented magnitude, yet in but a few months the Central Empires and their allies acknowledged, in the clearest and most unmistakable terms, their overwhelming and utter defeat.

In January, 1917, the naval and military chiefs of Germany reviewed the position with Teutonic thoroughness. Their conclusion was that unless there were some marked acceleration of the losses being inflicted on the enemy, a combination of causes, not the least of which was the Allied blockade, would inevitably bring about their own defeat. The situation was grave. It occasioned a desperate decision—unrestricted submarine warfare.

The fifth volume of "Naval Operations" is very largely devoted to the story of this penultimate phase. It is vitally interesting, but wholly impersonal. No man is hailed as the saviour of his country. No device is proclaimed as the invincible weapon of submarine warfare. The institution of the convoy system, the stimulation of the home production of food, the increasing of air and sea patrols, the use of the hydrophone, the employment of deep mining on a vast scale, the acceleration in shipbuilding, the more judicious selection of sea routes all played their part.

In April, 1917, our defeat appeared to be the only logical deduction from an examination of the statistical position. By March, 1918, the courage of our rulers, of our Navy and of our mercantile marine, combined with the energy and technical skill of our people, had conclusively overcome the submarine menace. It remained only for our blockade to overcome the *morale* of the peoples of the Central Empires.

The Quest for Power. By HUGH P. and MARGARET W. VOWLES. London: Chapman and Hall, Ltd. 8vo. 1931. Price 15s. net.

THE story of man's age-long struggle to obtain mastery over the powers of Nature for his convenience and enjoyment is here told with a breadth of treatment, lucidity of exposition and wealth of illustration that fascinates the reader. Books of this kind, although they may be facile, too frequently are marred by errors and exploded "kettle lid" stories—admittedly difficult to avoid—but on critical examination the statements made in this volume are found to be correct, and the balance throughout is well maintained. This is what should be expected, perhaps, when we say that one of the authors is an engineer and the other a historian, and that the MS. was read carefully by several eminent engineers and scientific men.

The matter is presented in three parts, or "books," roughly equal in length. Book One tells of man's apprenticeship of muscular toil for half a million years, during which he learnt to make and use flint tools, discovered fire and metals, and, in the earliest civilisation periods, controlled water for irrigation, built hugely and learnt how to transport material by land and water. In other words, in this period he acquired the skill and empirical knowledge necessary before he could succeed in harnessing the powers of Nature. In a note on Greek science, the authors rightly emphasise the emergence at that time of man's present attitude of logical thought about his environment.

Book Two tells of the coming of the age of power, a period at the utmost not one-hundredth of the length of its predecessor. Water-wheels and windmills were the first prime movers, but are dismissed cursorily for lack of space. The authors trace the transition from a purely agricultural age to that dependent on minerals—with the coming of the steam engine and its concomitant ever-rising tide of invention and discovery—during the last three centuries. The advent of the steam turbine, the internal combustion engine, and the hydraulic turbine with the resultant power development and its electrical transmission leads to the conclusion: "With this splendid gift of science has come the promise of a new way of life for all mankind, the possibility of human existence being freed for ever from the body and soul-destroying drudgery of uncongenial toil."

Book Three discusses the materials with which results have been achieved—mainly coal and steel—with present limitations. In an Epilogue the authors touch upon the World Power Conference and possibilities of the future. Their verdict on the evidence is that: "The end is nowhere in sight. On the contrary, it is clear that such developments are even now in their initial stages, a mere foreshadowing of what is still to come." We hope every engineer will spare the time to read this book, not only to make himself acquainted with the history of his profession, but also to drink in some of the authors' optimism.

SHORT NOTICES.

Experimental Radio Engineering. By John H. Morecroft. London: Chapman and Hall, Ltd. Price 17s. 6d.—Dealing specifically with the teaching of wireless principles in the laboratory, this volume has a field of its own, for as far as we know no other book covers exactly the same ground. The author's aim is to emphasise the principles involved in the performance of wireless apparatus, rather than to deal with its specific operation. A factory test man, he explains, can generally undertake the work of adjusting a wireless receiver in routine fashion just as well, if not better, than the graduate of the best engineering school, and it is of little value to the engineering student to spend much time on work of this nature. Rather should his efforts be directed to mastering the relationships of the multitudinous factors which affect the performance of a receiver. Tests are described which bring out the characteristics of the component parts of transmitting and receiving apparatus, whilst other tests are designed to show how one part affects the operation of another. An introduction to the book deals, among other things, with the reasons for performing some of the tests at low frequencies, meters for use in the wireless laboratory, coils suitable for low-frequency experiments, and condensers. The remainder of the volume is devoted to fifty-one experiments.

Fractional Horse-power Motors. By A. H. Avery. London: Sir Isaac Pitman and Sons, Ltd. Price 7s. 6d.—Although many books have been written on the design of electric motors, the design of very small machines seems to have been rather neglected, and the object of this book is to bridge this gap in electrical literature. The motors considered are distinct from those which are made and sold for the amusement of boys and which have no commercial or domestic value. Fractional horse-power motors, as dealt with in the book, are in no sense toys. They are intended for useful work, and although they give small outputs, they are built on substantial lines. Insignificant as these motors may be from the point of view of size, they now play an important part in commercial and domestic affairs, and in view of the large demand for them they cannot be neglected by electrical engineers. The design of these small machines, however, calls for special knowledge, which many electrical designers may not possess, and those who desire to familiarise themselves with this particular branch of electrical manufacture should find this book useful. No attempt has been made, however, to do more than cover the essential points. Although for the most part the author concentrates on design, attention is also paid to such matters as testing and fault localisation.

Wireless. By L. B. Turner. Cambridge University Press. Price 25s.—This book is a development of the author's "Outline of Wireless," published in 1921 and now out of print. The present volume is nearly three times as large as its predecessor, little of which now remains. The field which the book covers is that of wireless telegraphy and telephony, and it deals with the principles and the most prominent present-day practice. Those who desire to acquire a general knowledge of the subject of modern wireless communication will find the whole of the book useful, whilst those who wish to confine themselves more particularly to the engineering side of the subject will only need to study certain sections of the volume. The rigorous division of the chapters into titled sections and sub-sections and the provision of a full index facilitate the use of the book for reference by those who have passed the stage on consecutive text-book reading. As an experienced teacher of the subject, the author is in a good position to know what the student requires and in what order the book should be read by those who have not studied the subject before, and guidance in this matter is accordingly provided. From the point of view of students and others who desire to study wireless seriously the book is undoubtedly of great value, but it is not a book we should recommend to those who dabble in wireless as a hobby and who are not greatly interested in the theoretical side of the subject.

Quartz Resonators and Oscillators. By P. Vigoureux. London: His Majesty's Stationery Office. Price 7s. 6d.—In view of all the work that has been carried out with piezo-electric quartz resonators and oscillators within recent years, and all that has been published on the subject, the Radio Research Board has deemed it desirable to arrange for the publication of this monograph summarising the main aspects of the subject and co-ordinating the results obtained. The preparation of the monograph was entrusted to Mr. P. Vigoureux, who has worked under the general supervision of Dr. D. W. Dye, at the National Physical Laboratory. The monograph begins with a description of quartz crystals, but it deals mainly with the practical applications of the piezo-electric properties of quartz to radio technique. After a summary of the physical properties of quartz with special stress on the piezo-electric effect, there is an account of the discovery of piezo-electricity by the brothers Courie in 1880, and the early applications of quartz which resulted from their work, whilst in later chapters the more recent discoveries and applications of piezo-electric quartz are reviewed and critically examined. Finally, the internal structure of quartz and the attempts made by physicists to explain piezo-electricity on the bases of internal structure are considered. An attempt has been made throughout the volume to direct attention to points which have not been satisfactorily settled and which seem to require further research.

BOOKS RECEIVED.

The Bridges of the Rhine. By K. Möhringer. London: Karl Möhringer, 38, Bernard-street, W.C. 1. Price 25s. net.

Direct-current Machine Design. By A. W. Hirst, M.Sc. London: Blackie and Son, Ltd., 50, Old Bailey, E.C. 4. 10s. net.

The Balancing of Machinery. By C. N. Fletcher. London: Emmott and Co., Ltd., 28, Bedford-street, W.C. 2. Price 10s. net.

Trigonometry for the Practical Man. By J. E. Thompson. London: George Routledge and Sons, Ltd., 68–74, Carter-lane, E.C.4. Price 7s. 6d. net.

Arithmetic for the Practical Man. By J. E. Thompson. London: George Routledge and Sons, Ltd., 68–74, Carter-lane, E.C. 4. Price 7s. 6d. net.

Algebra for the Practical Man. By J. E. Thompson. London: George Routledge and Sons, Ltd., 68–74, Carter-lane, E.C. 4. Price 7s. 6d. net.

Calculus for the Practical Man. By J. E. Thompson. London: George Routledge and Sons, Ltd., 68–74, Carter-lane, E.C. 4. Price 7s. 6d. net.

Practical Railway Operating. By T. Bernard Hase. London: Modern Transport Publishing Company, Ltd., 105–109, Strand, W.C. 2. Price 5s. net.

The Physics of High Pressure. By P. W. Bridgman, Ph.D. London: G. Bell and Sons, Ltd., York House, Portugal-street, W.C. 2. Price 22s. 6d. net.

Reinforced Concrete Reservoirs and Tanks. By W. S. Gray, B.A., &c. London: Concrete Publications, Ltd., 20, Dartmouth-street, S.W. 1. Price 10s. net.

Tests on Timber Pit Props. By S. M. Dixon and M. A. Hogan. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 2s. net.

Electricity for Coal-mining Students. By J. Stevenson, M.C., and W. Miller, B.Sc. London: Crosby Lockwood and Son, Stationers' Hall-court, E.C. 4. Price 7s. 6d. net.

Dynamics of Airplanes and Airplane Structures. By J. E. Younger and B. M. Woods. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 17s. 6d. net.

Metallographers' Handbook of Etching. Compiled by T. Berglund. Translated by W. H. Dearden. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 12s. 6d. net.

The Students' Text-book of Reinforced Concrete: Theory and Practice. By R. P. Mears, B.A., &c. Bombay: The Concrete Association of India, Telephone Buildings, Home-street, Fort. Price 5 rupees.

A New Type of High-Speed Heavy-Oil Engine.

By S. J. DAVIES, Ph.D., M.Sc., M.I. Mech. E.

One of the most striking features to be noticed in a survey of the development of heavy-oil engines running at high speeds of revolution is the extraordinary variety of designs for which some degree of practical success is claimed. In general, however, the types of combustion chamber fall fairly clearly into one of the three classifications, "direct injection," "ante-chamber," and "auxiliary air chamber." A type of combustion chamber which, however, does not fall directly into one of these divisions is that of the "Omo" engine, of the Omo A.G., of Zürich.

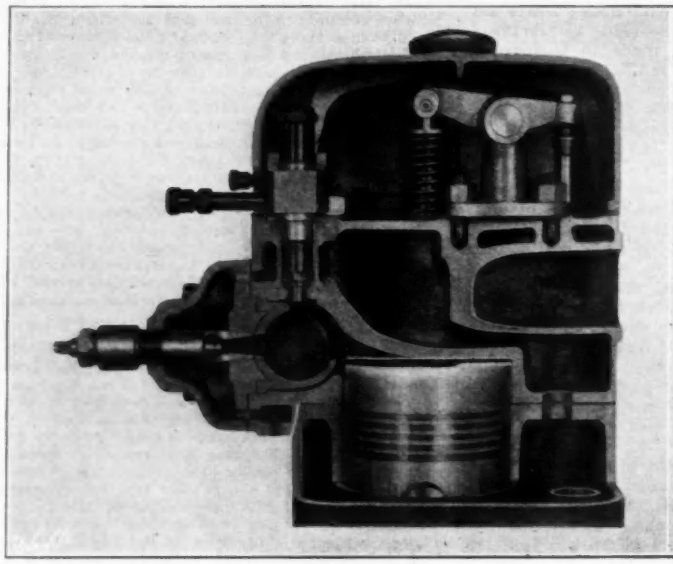


Fig. 1—Cross Section of Cylinder Head

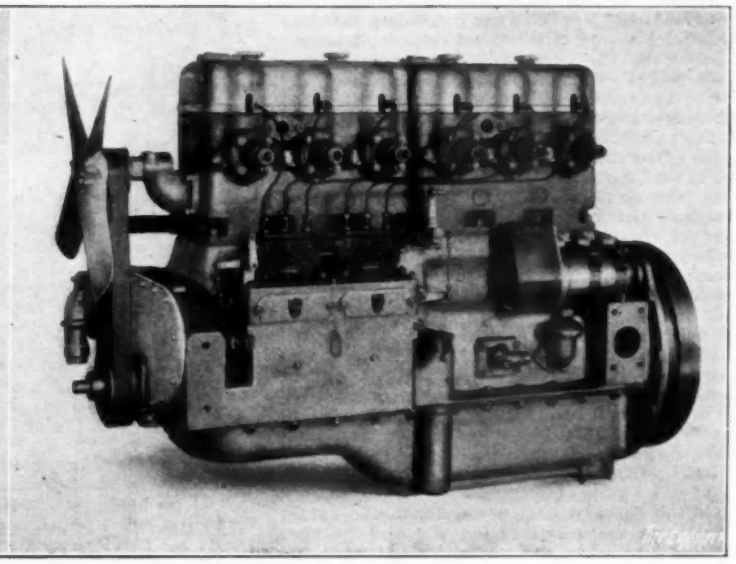


Fig. 2—Outside View of Six-Cylinder Engine

The method of working of this engine is of considerable interest technically, as a solution in many ways novel, and will be discussed at some length. Following this, an account will be given of some tests which the author carried out recently on three engines of this type. These tests were made at the Oberhänsli Works, at Bregenz, Austria, where the development of the engine has taken place.

Fig. 1 shows a cross section through the combustion chamber, with the piston at top dead centre. It is seen that, apart from the minimum clearance necessary between the top of the piston and the underside of the cylinder head and valves, the combustion chamber is roughly spherical in form, the injection nozzle, in the engine shown, being placed vertically with its centre line passing through the centre of the sphere. The distinguishing features of the design, however, are :—(*a*) The hollow bowl-shaped hot body, which serves as a reservoir of heat in the combustion chamber, and (*b*) the method by which suitable motion is given to the air entering the spherical chamber.

The bowl-shaped hot body is secured to the cylinder head in the manner shown. Its inner surface is nearly spherical in form, and is somewhat greater in extent than that of the corresponding hemisphere. On the outer side of the hot body, apart from where it is secured to the cylinder head, an air space or "clearance" is provided. This acts as a heat insulator, preventing a too rapid loss of heat from the body to the water-cooled walls, and ensuring that the mean temperature of the body is at a level corresponding to satisfactory working. This clearance and the thickness of the hot body itself are somewhat critical, and are matters for experiment with each cylinder size. In starting the engine, the necessary heating of the air, as normally effected by the hot body, is supplied by a heating coil. The hot body rapidly acquires a sufficiently high temperature, when the coil may be switched off. The heating coil is shown horizontally in the figure, and is of usual design. Injection takes place through a nozzle of the pintle type, the jet being "soft" and fairly divergent in character. This brings us to the manner in which the air and fuel are caused to mix.

It will be noticed that the passage connecting the spherical combustion chamber with the main working cylinder is a constricted one. Actually, owing to the fact that the form of the cylinder head casting is such that the cross section of the opening next to the piston forms roughly an inverted V, the constriction is more marked than would appear in the figure. The opening in the hot body is, of course, made to conform to this shape. As a result of this construction, the air being forced into the combustion chamber by the piston during the compression stroke, and especially towards the end of this stroke, is mainly directed towards the jet. Such a motion of the air will materially assist in breaking up the jet and in bringing about an intimate mixing of the fuel and air. It will, at the same time, by setting up a vigorous rotational swirl of the air in the hot body, render possible the rapid transfer of heat from the hot body to the air and fuel which is desirable for satisfactory ignition and combustion of the fuel. Incidentally, since by far the greater proportion of the air is contained in the combustion chamber, it is reasonable to assume that the combustion process itself takes place mainly in that chamber. In view of the troubles experienced with some heavy-oil engines, owing to the interaction of the fuel oil with the lubricating oil, this may prove an important advantage in service.

It is interesting, at this point, to consider this engine in relation to other types of design. It is, of course, distinguished from "hot bulb" engines in that the instant at which combustion begins is determined not mainly by the temperature of the hot body, but, as in other high-speed heavy-oil engines, by the timing of injection. The action of the hot body up to the instant of injection is exclusively directed to heating the air. Apart from the action of the hot body, the combustion is of the "direct injection" type, with "piston swirl," that is, the air swirl is produced by the piston motion and not by the conditions governing the induction of air into the cylinder. Owing to the action of the hot body, however, the high injection pressures usual in "direct injection" engines are not necessary, the pressures actually used being of the order of those usual in ante-chamber engines—that is, with a maximum of 2000 lb. per square inch. In short, the hot body renders the combustion less dependent upon, and less sensitive to, the injection conditions. Apart from injection, however, the design has little relationship, either with the "ante-chamber" or with the "auxiliary air chamber" types, in spite of the way in which the combustion chamber is divided.

Although the design in its present form is new, in that its development has taken place since the war, the principle upon which it works is an old one of the Oberhänsli Company. As far back as 1913† this company was successfully manufacturing engines which were intermediate in type between hot-bulb engines and pure air-injection or Diesel engines; that is, they employed direct or airless injection of the fuel into the cylinder, which was provided with a "hot body" to raise the temperature of the air to assist the ignition of the fuel. The chief differences between these older engines and those built to-day lie in the respective forms of the combustion chambers—the older form had a "sugar-loaf" or conical compression space, co-axial with the cylinder, with axial injection, the hot body being in the form of a ring partially closing this space immediately above the piston. The speeds of revolution have become much higher, and, to improve the thermal efficiencies, the working pressures in the cylinders have been raised. The older engines naturally used injection pumps and nozzles of Oberhänsli design. Those of to-day employ Bosch equipment throughout in the form of fuel pumps and nozzles, while the heating coils used in starting are also made by that firm.

With the technical development of the "Omo" design, the possible fields of application of the engines have naturally also widened. The earlier engines were built mainly for stationary purposes. Those built to-day, with their higher speeds of revolution, are employed, in addition, for transport purposes by land and water. For instance, the engines whose tests are to be described comprised a six-cylinder lorry engine A, with a normal speed of 1800 r.p.m.; a four-cylinder engine B, designed for lorry or marine purposes, running normally at 1450 r.p.m.; a single-cylinder experimental engine C, running up to 3000 r.p.m. Of these, engine A was tested completely on the bench over extreme ranges of speed and load; certain supplementary tests on the bench were made upon engine B to confirm the progress made with the engine since the independent tests of Professor Nägel in January, 1931; finally, tests were made upon engine C, which is admittedly still in the experimental stage, to confirm the marked advance towards high speeds of revolution made with this design.

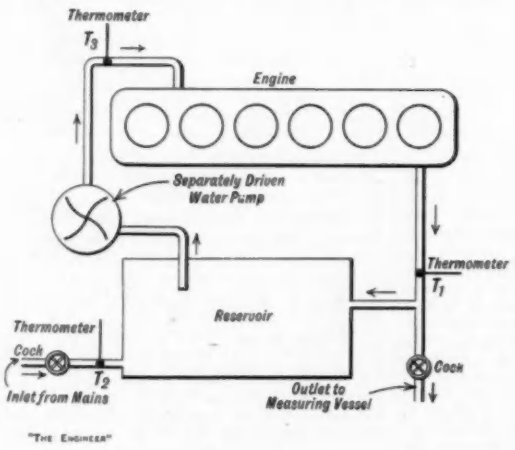


Fig. 3—Circulating Water Measuring Arrangements

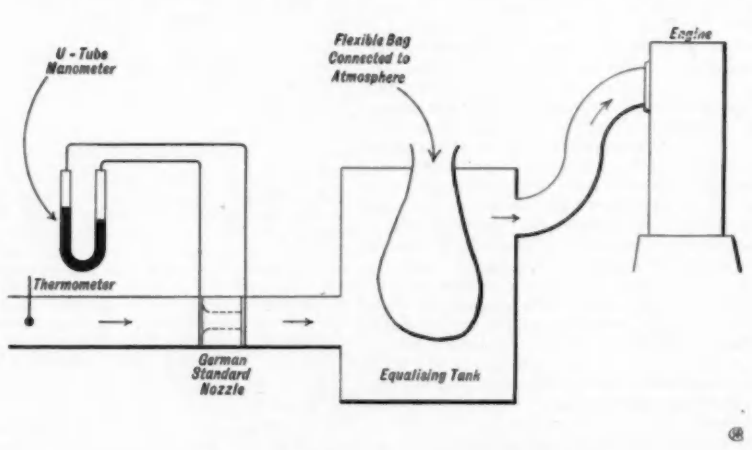


Fig. 4—Air Measuring Arrangements

Tests of Six-cylinder Lorry Engine.

This engine is shown in side elevation in Fig. 2. The head, whose cross section is given in Fig. 1, belongs also to this engine. Apart from the special features already described, the engine follows normal practice in its design. The cylinder bore is 110 mm. (4·32in.) and the stroke 160 mm. (6·3in.), giving a total swept volume of 9·12 litres for the six cylinders. The normal speed of revolution is 1800 r.p.m., with 2000 r.p.m. as a maximum.

The object of the tests was to investigate as completely as possible the performance of the engine over wide ranges of speed and load. Tests were accordingly made at all

† See *Oel- und Gasmaschine*, November, 1913.

loads from light to full at speeds of 600, 930, 1370, 1620, 1810 r.p.m., while a single test for maximum output is recorded at 2018 r.p.m. Observations were made of the speed, the brake load, the fuel consumption, the heat to the circulating water, the exhaust temperatures—at 1810 r.p.m. only—and the air consumption.

The tests were made between July 27th and 31st, 1931, when the barometer stood at about 28·5in. of mercury—Bregenz is some 1300ft. above sea level—while the air temperature was about 70 deg. Fah. During the tests the engine was in its normal running condition, with the exception that, for reasons which are given below, the water circulating pump was separately driven and the fan was disconnected; the lighting dynamo was, however, in action. Check tests, made afterwards by the firm, of the power taken by the water pump and by the fan when running at normal speeds showed that each absorbed approximately 0·5 kW.

The speed of the engine was observed by a revolution counter, timed over the period during which the fuel consumption was measured. The power was absorbed and the brake torque measured by a Junkers hydraulic brake; the brake was afterwards disconnected, balanced, and measured in order to check the brake constant. The fuel consumption was found by observing the interval of time taken to consume a certain weight of fuel. This weight was varied to give always a reasonable timing interval, intermediate readings also being taken to control the constancy of the running. The fuel balances were afterwards checked and found correct. For the circulating water special arrangements were made to simulate, on the bench, the conditions to be met with in service.

When running in the lorry the rise of temperature of the circulating water in passing through the engine is much smaller than that when, as is common in bench tests, cold water from the mains is led directly to the engine. The water pump was therefore, as stated earlier, disconnected from the engine and separately driven, and the water arranged to flow around the circuit given in Fig. 3. With this arrangement the quantity of water in the system is controlled to be constant during a test; that is, the amount of fresh water from the mains is kept equal to that discharged. The quantity of water being circulated through the engine is, however, much greater than that flowing away from the system. Thus, while the rise of temperature of the water flowing through the system is (T_1-T_2), the rise of temperature of the water in flowing through the engine is only (T_1-T_3). T_3 was arranged to be some 25 deg. Fah. below T_1. The water flowing out of the system was weighed, these values multiplied by (T_1-T_2) giving the heat quantities passing to the circulating water.

The exhaust temperatures were read by thermo-couples. The latter were afterwards calibrated and the temperatures given are those from the calibrations. The practical difficulties of measuring accurately the temperatures of pulsating currents of gas render these values, as is almost invariably the case with engine tests, only relative. But readings of exhaust temperature are, nevertheless, valuable.

The air consumption of the engine was measured by means of the equipment shown in Fig. 4. The diameter of the German standard nozzle was 50 mm., and, in evaluating the results, a coefficient of discharge of 0·96 was taken. By the action of the equalising tank the pressure fluctuations shown by the manometer were satisfactorily reduced, even at the lowest speeds.

A sample of the fuel used was submitted to Mr. Harold Moore, petroleum technologist, of Moore and George, Ltd., 181, Queen Victoria-street, E.C. 4. He found it to be a good petroleum gas oil of specific gravity 0·856 at 60 deg. Fah., with a closed flash point of 165 deg. Fah., a gross calorific value of 19,768 B.Th.U., and net calorific value of 18,499 B.Th.U.

The essential data observed and calculated from the tests are tabulated in the Table, while Figs. 5 to 8 show curves plotted from the test data. Fig. 5 gives curves of fuel consumption in pounds per B.H.P. per hour for each series plotted on a base of brake mean pressure, and illustrates the more important facts of the performance of the engine. On this figure, too, are given the exhaust temperatures—means of all six cylinders—recorded in the series at 1810 r.p.m.

The state of the exhaust was, naturally, always carefully observed. The exhaust from the six cylinders was collected in a manifold and led through a pipe 15ft. long to the open air. In all test series the load on the engines was progressively increased. At the lower loads the exhaust, however viewed, was absolutely invisible; with the increase of load a point was reached at which the exhaust was just visible, and a test was always taken at that point. These tests, marking the limit of what may be called "perfect" exhaust, are starred in the Table. The values of brake mean pressure and brake horse-power from these tests are further plotted on a base of r.p.m. in Fig. 8. Such a treatment of exhaust conditions may appear somewhat drastic, but in view of the attention being directed to this matter of exhaust, it was thought desirable to give special care to this examination. In fairness to the engine, however, it should be stated that at the lowest speed of 600 r.p.m. the limit is not very marked, and the brake pressure of 39·8 lb. per square inch, starred, by no means marks the limit of "satisfactory" exhaust; in fact, not until 69·5 lb. per square inch was the exhaust objectionable. At the higher speeds the limit was fairly clearly marked, as is usually the case with oil engines, but in none of the tests recorded was the exhaust really unsatisfactory in the light of usual standards. The question of what constitutes a satisfactory exhaust is admittedly an indefinite one—the provision of some standard of comparison would be a great boon—but in the present tests the author has always erred on the exacting side.

In considering the general performance of the engine the most striking thing to be noticed in Fig. 5 is the extraordinary similarity of the curves of performance. There are, of course, two distinct factors to be noted in comparing the curves at various speeds, namely, the effect of changes in the combustion conditions, and the natural decrease of mechanical efficiency with increase of speed. In spite of these factors, the curves for all speeds from 930 to 1810—that is, leaving out series A at 600—are practically identical. Below half load all curves fall together, and the economy at reduced loads at all speeds is remarkably good.

As regards the question of maximum output, there are two points to be borne in mind: owing to the high altitude

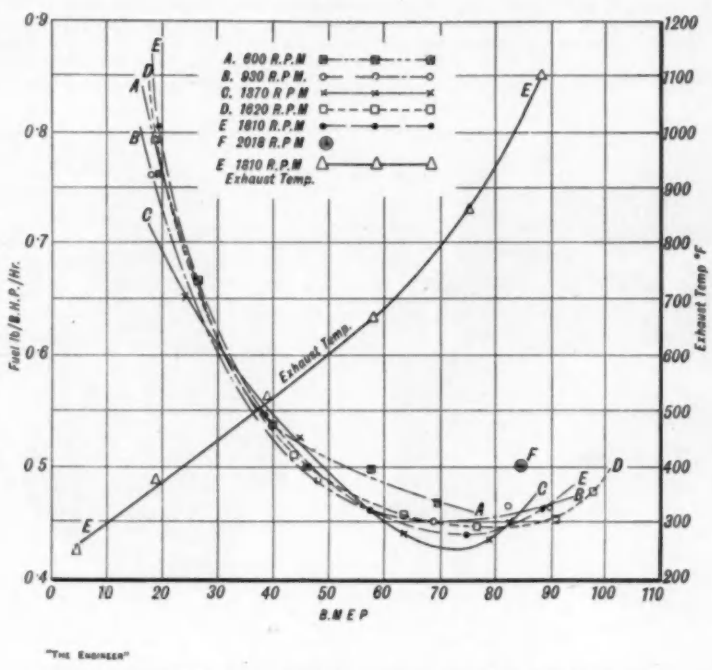


FIG. 5—CURVES OF FUEL CONSUMPTION AND EXHAUST TEMPERATURE

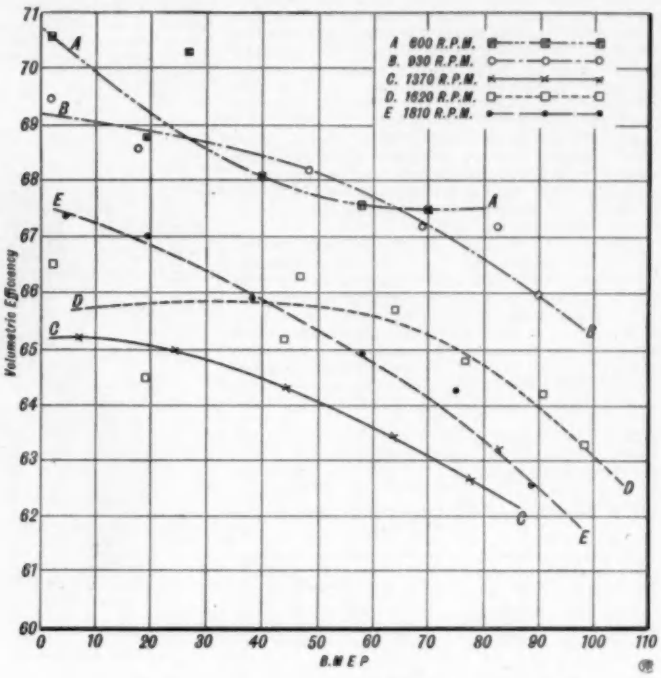


FIG. 6—CURVES OF VOLUMETRIC EFFICIENCY

Observed and Calculated Data.

Test No.	Speed, r.p.m.	B.M.E.P., lb. per sq. in.	B.H.P.	Fuel, lb. per B.H.P. per hour.	Cooling water, B.Th.U. per B.H.P. per hour	Volumetric efficiency (N.T.P.).	Ratio, Air used / Correct air.
A.1	601	1·9	0·8	5·120	49,600	70·6	5·56
2	606	18·95	8·1	0·763	5,920	68·8	3·65
3	616	26·2	11·3	0·668	—	70·3	2·98
4	612	*39·8	*17·1	0·538	3,540	68·1	2·62
5	615	57·5	24·8	0·499	3,700	67·7	1·81
6	618	69·5	30·2	0·470	3,182	67·5	1·58
B.1	942	1·9	1·25	5·210	54,000	69·5	5·2
2	954	17·8	11·86	0·762	5,240	68·6	3·9
3	940	48·0	31·7	0·482	3,390	68·2	2·26
4	935	68·8	45·2	0·451	2,395	67·2	1·66
5	930	*82·1	*53·6	0·465	2,580	67·2	1·35
6	940	89·7	59·2	0·463	2,365	66·0	1·22
C.1	1374	6·95	6·7	1·66	18,820	65·2	4·35
2	1353	24·0	22·8	0·654	5,260	65·0	3·18
3	1371	44·5	42·9	0·527	2,870	64·3	2·10
4	1370	63·2	60·8	0·442	3,210	63·4	1·75
5	1373	77·7	75·0	0·432	3,300	62·7	1·44
6	1382	*82·1	*79·8	0·450	2,955	63·2	1·30
D.1	1616	1·9	2·2	6·61	35,300	66·5	4·07
2	1644	18·3	21·15	0·794	6,040	64·5	3·4
3	1611	43·6	49·3	0·511	3,180	65·2	2·25
4	1611	46·2	52·2	0·500	3,090	66·3	2·21
5	1612	63·2	71·5	0·458	2,860	65·7	1·74
6	1620	76·5	86·9	0·447	2,420	64·8	1·46
7	1618	*90·4	*102·7	0·454	2,420	64·2	1·2
8	1613	98·0	111·0	0·480	2,395	63·3	1·03
E.1	1813	4·1	5·2	2·72	23,500	67·4	4·61
2	1816	18·95	24·2	0·805	5,250	67·0	3·35
3	1814	38·55	49·1	0·546	2,800	65·9	2·41
4	1811	57·8	73·1	0·461	2,465	64·9	1·88
5	1807	74·9	95·0	0·440	2,090	64·2	1·5
6	1818	*88·5	*113·0	0·463	2,180	62·6	1·17
F.1	2018	*84·7	*119·8	0·503	—	61·6	1·11

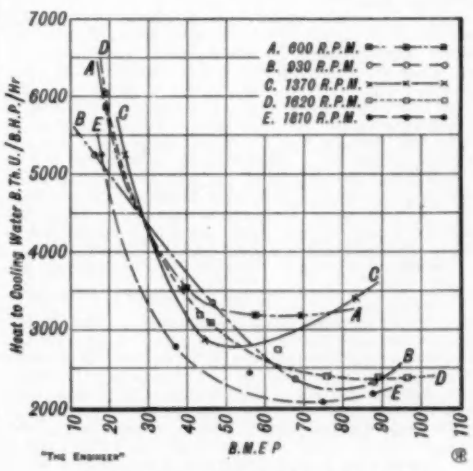


FIG. 7—HEAT TO CIRCULATING WATER

of Bregenz the barometer readings only averaged 28·5in.; the room temperature was usually 70 deg. Fah. The effect of this on the quantity of air aspirated, when compared with normal conditions of a 29·92in. barometer and a temperature of 60 deg. Fah., is to lower this quantity by some 5 per cent. This should add at least 5 lb. per square inch to the highest values of the brake mean pressure.

Higher outputs than those recorded could undoubtedly have been attained at most speeds, but unless these can be realised with a reasonably clear exhaust, they have, in normal practice in this country, little value. For exceptional circumstances, as those obtaining in thinly populated mountainous countries, such as Austria and Switzerland, it is of interest to know the actual maximum horse-power the engine will deliver regardless of the state of the exhaust. Thus two maxima were actually observed on the engine. The point F on Fig. 5 shows the maximum permissible output with clean exhaust, namely, 119·8 B.H.P. It was obtained at 2018 r.p.m. and the corresponding fuel consumption was 0·503 lb.—an excellent result at this speed of revolution. A further test, with smoky but not quite black exhaust, showed that a brake mean pressure of 92 lb. per square inch was possible at this speed, giving an absolute maximum output of the engine, in its present state of development, of 130 B.H.P. The low barometer reading must, of course, also be borne in mind when judging these results.

As regards the maximum recorded overall thermal efficiency of the engine, 29·8 per cent., corresponding to a specific fuel consumption of 0·432 lb., this must be considered good for a combustion chamber in which the surface to volume ratio is relatively high. For a lorry engine, however, the fact that in all tests between half and full load the consumptions were not appreciably greater than 0·5 lb., in spite of the considerable speed range, is of greater practical importance than the achievement of an extremely high efficiency at one single speed and load.

The quantities of heat given to the circulating water, in B.Th.U. per B.H.P. per hour, are plotted on a base of brake mean pressure in Fig. 7. No conclusions can reasonably be drawn from these curves, except that they are in accordance with results from similar engines, and

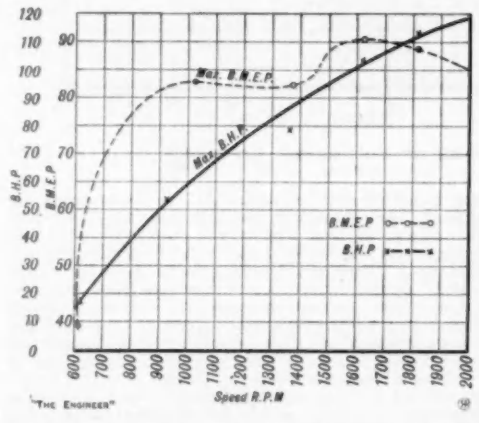


FIG. 8—MAXIMUM OUTPUT, SIX-CYLINDER ENGINE

that at normal speed and full load the radiator is called upon to dissipate some 280,000 B.Th.U. per hour, rising to some 300,000 B.Th.U. per hour under exceptionally severe conditions.

The measurement of the air consumption to the engine revealed some interesting data. The values of the volumetric efficiency, based on N.T.P., found from the respective series are plotted in Fig. 6 on a base of brake mean pressure. The vertical scale of this diagram is a very open one, and shows that the relative experimental errors from test to test were small. The position of the curve for series E, at 1370 r.p.m., appears too low by, perhaps, 2 per cent. This would appear to be due to critical pulsations either in the inlet or exhaust pipes, or both, at this speed. The effect of altitude and temperature is most marked in connection with volumetric efficiency; the corresponding values at sea level and at 60 deg. Fah. would be increased by some 3·5 per cent.

The last column in the table gives for each test the ratio: $\frac{\text{Air used}}{\text{"Correct" air}}$, this ratio being the weight of air actually used, divided by that theoretically necessary for complete combustion, and shows that the "excess air" at full load with clear exhaust is only of the order of 17 to 35 per cent. over the speed range from 930 r.p.m. to 1810 r.p.m., indicating that the air is used very efficiently. As a check upon the readings of air consumption at the normal speed of 1810 r.p.m., samples were taken of the exhaust gas. These were analysed at the Polytechnikum at Zürich, and it was found that with a brake mean pressure of 80 lb. the CO_2 content was 11·2; O_2, 5·2; H_2, 0·4, and N_2, 83·2 per cent. No trace of CO was found in the exhaust gas. The CO_2 content corresponds with 35 per cent. of excess air, which falls quite well between the respective values of 17 per cent. at a brake mean pressure of 88·5 lb. and 50 per cent. at 74·9 lb. for tests E. 5 and E. 6 in Table I. The absence of CO points also to efficient combustion. This is an advantage of a well-designed heavy-oil engine over the best petrol engine, with at least 3 per cent. of CO, which is often not sufficiently emphasised.

It only remains to be added that the combustion takes place with a relative absence of "combustion knock," so that, from the point of view of silent running the engine was quite satisfactory, making no more noise than a petrol engine of similar dimensions and power. It ran throughout the tests smoothly and without undue vibration.

Tests of Four-cylinder Lorry Engine.

Fig. 9 shows a side elevation of the four-cylinder engine. The cylinder bore is 130 mm. (5·11in.) and the stroke 180 mm. (7·08in.), giving a total swept volume for the four cylinders of 9·55 litres. The normal speed is now 1450 r.p.m., with 1600 r.p.m. as a maximum.

"Complete bench tests of this engine were made in January last by Professor Nägel, of Dresden; these were followed by tests of its performance in a lorry by Professor Richter, of Vienna. The object of the tests carried out by the writer was to give independent confirmation of the progress which has been made on the engine since the beginning of the year. In his report, dated February 14th, 1931, Professor Nägel said:—

"As a Diesel engine the engine is distinguished by the complete combustion that results from the special form of the combustion space; this ensures a clear exhaust under all speeds and loads. The effect of this form, combined with the application of a hot body, permits of the use of relatively low injection pressures. From this fact may be explained the especially soft running of the engine, both when running light and when under load. The ignition and exhaust noises can, for a Diesel engine, be regarded as extremely slight.

"The running of the engine was, especially during the

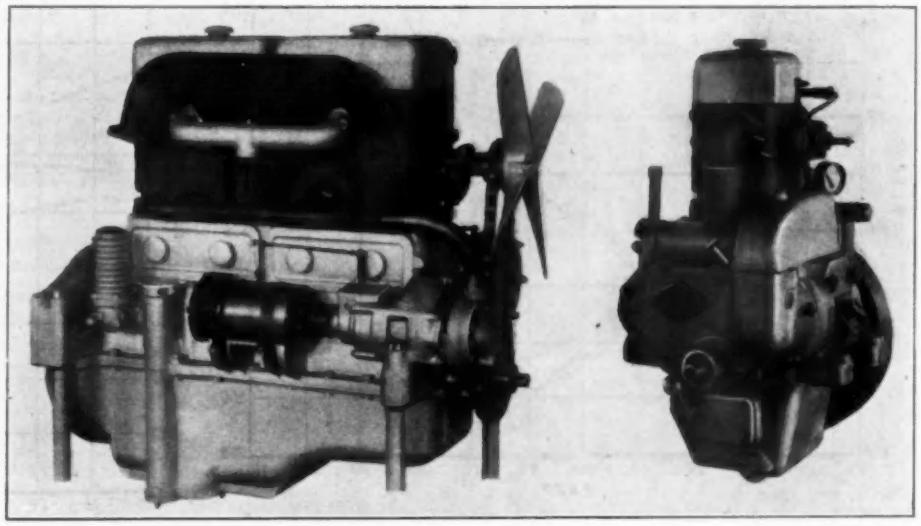


FIG. 9—SIDE VIEW OF FOUR-CYLINDER ENGINE

FIG. 10—SINGLE-CYLINDER EXPERIMENTAL UNIT

road tests in the lorry, surprisingly smooth. And it should here be mentioned that the engine was built into the lorry with four-point suspension, tightly screwed down and without india-rubber packing. The noise of the engine under load was then no greater than that of a petrol engine of equal horse-power. When running light, the engine, as a result of its somewhat higher speed of revolution, ran slightly harder than the corresponding petrol engine. No objectionable vibrations were observed over the whole range of speed.

"By permitting incomplete combustion, giving a black exhaust, a maximum output of 96·5 P.S.—*i.e.*, 95·5 H.P.—both at 1350 r.p.m. and at 1500 r.p.m., was attained. At maximum speed—1500 r.p.m.—by a slight reduction of output to 89 P.S.—*i.e.*, 88·1 H.P.—a clear exhaust was possible, while for the normal speed of 1350 r.p.m. this limit was about 86·5 P.S.—*i.e.*, 85·6 H.P. These tests

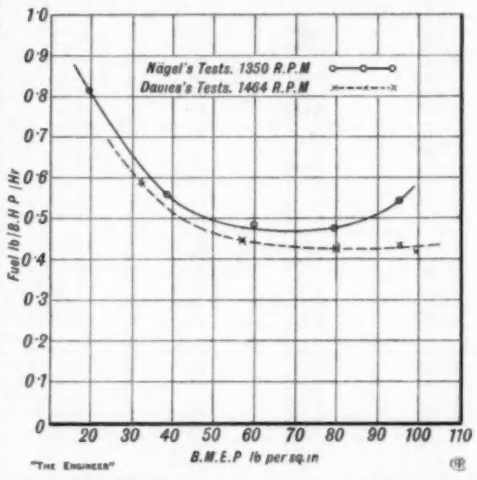


FIG. 11—FOUR-CYLINDER ENGINE PROGRESS

showed that the engine can develop 80 P.S.—*i.e.*, 79·1 H.P.—continuously at normal speed.

"From the air consumption measurements it is seen that the engine develops the nominal output of 80 P.S. with 43 per cent. excess air, which is reduced to about 30 per cent. at 90 P.S. In so far, therefore, that no increase of the efficiency of the engine is effected by improvements to the valve gear, the limit of output of the engine lies, at present, at about 90 P.S.—*i.e.*, 89·1 H.P.—at 1350 r.p.m. and 95 P.S.—*i.e.*, 94 H.P.—at 1500 r.p.m.

"From the test results it appears that the design of combustion space used in the Oberhänsli engine is capable of overcoming to a large extent those difficulties which are met with in the application of the Diesel engine to transport purposes. The design has proved itself completely satisfactory in service. It gives, by the advantages and characteristics already described in detail in this report, the possibility of its entering at every stage of development into successful competition with the petrol engine and with other transport Diesel engines."

The author tested this engine on the bench at Bregenz on September 15th, 1931, at a barometer of 28·8in. and a room temperature of 67 deg. Fah. In all other respects the test conditions and plant were similar to those described earlier for the six-cylinder engine. The observations, however, were limited to those of speed, brake load, and fuel consumption.

The normal and maximum speeds of the engine had been increased from 1350 r.p.m. and 1500 r.p.m. in Professor Nägel's tests to 1450 r.p.m. and 1600 r.p.m. respectively. Two series of tests were made: (*a*) a series at normal speed and gradually increasing load; (*b*) a series at a number of speeds, the load, at each speed, being increased to give the maximum output consistent with an exhaust that was just visible—that is, the limit of "perfect" exhaust referred to earlier—observations being taken at this load.

The results of series (*a*) are given as specific fuel consumption on a base of brake mean pressure in Fig. 11. This is the lower curve, the upper one being that obtained in January by Professor Nägel at the then normal speed of 1350 r.p.m. Apart from the increase in speed, there are two improvements to this characteristic curve to be observed in this figure: the general level of fuel consumption is lower, and, what is more important, the limit of brake mean pressure with "perfect" exhaust has been increased from 79 lb. to 96 lb. per square inch, with an improvement in consumption from 0·475 lb. to 0·44 lb.

As a result of this improvement to the engine characteristic, the better performance revealed by series (*b*), plotted in Fig. 12, is quite to be expected. The curve of maximum brake mean pressure with "perfect" exhaust rises steadily with the speed, and would indicate that the output of the engine is limited more by mechanical than by combustion conditions. When comparing the outputs with those mentioned by Professor Nägel, it is seen that at 1350 r.p.m., 93 H.P. is now given instead of 79·1, while, as a consequence of the increase in the normal speed, the engine can now develop under continuous load

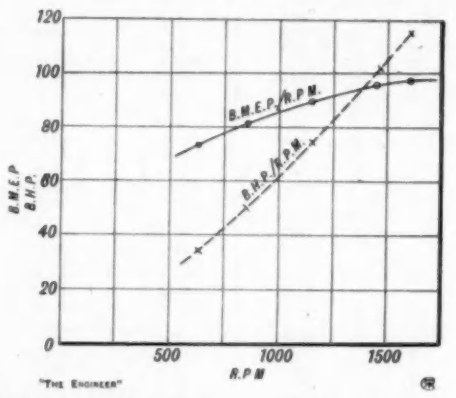


FIG. 12—MAXIMUM OUTPUT OF FOUR-CYLINDER ENGINE

at 1450 r.p.m., 103 H.P. instead of 79·1, an increase of rating of 30 per cent. The maximum output, again with perfect exhaust conditions, has similarly been raised from 88·1 H.P. to 116 H.P., the corresponding increase of possible output per litre being from 9·23 to 12·14 H.P. per litre.

Tests of Single-cylinder Experimental Engine.

Some check tests upon a single-cylinder experimental engine—see Fig. 10—of 70 mm. (2·76in.) bore and 120 mm. (4·72in.) stroke, and swept volume of 0·46 litre, were also made at Bregenz on September 15th, 1931. The atmospheric conditions were those mentioned for the four-cylinder engine tests, but a Prony brake was used instead of the Junkers brake for power measurement.

The object of these tests was to give independent confirmation of the results possible at the stage of development reached at the date of the tests. The tests are of especial interest, owing to the fact that the engine is intended to run at a normal speed of 3000 r.p.m.

Two tests were made, the engine in each test being observed to run consistently for some 30 minutes. The engine had been running during the greater part of the

day under the indirect observation of the author. In the first test, which was at 2600 r.p.m., the brake load corresponded to a brake mean pressure of 83·2 lb., giving a brake horse-power of 7·7. The exhaust was just visible, and the fuel consumption was found to be 0·62 lb. per brake horse-power per hour. In the second test, which was at 2800 r.p.m., the brake load was reduced to ensure a clear exhaust, corresponding then to a brake mean pressure of 69·4 lb., giving a brake horse-power of 6·92. The fuel consumption was then 0·72 lb. per brake horse-power per hour.

It should be stated that, on account of the minute quantities of fuel to be measured, the accuracy of the fuel measurement is probably correct only to plus or minus 4 per cent., but the results for speed and power, and, of course, the exhaust observations, are reliable.

The interest of the results lies in the high speeds of revolution and the high specific output—16·7 H.P. per litre—demonstrated by these tests made at what is regarded as an early stage in the development of this small engine.

Conclusions.

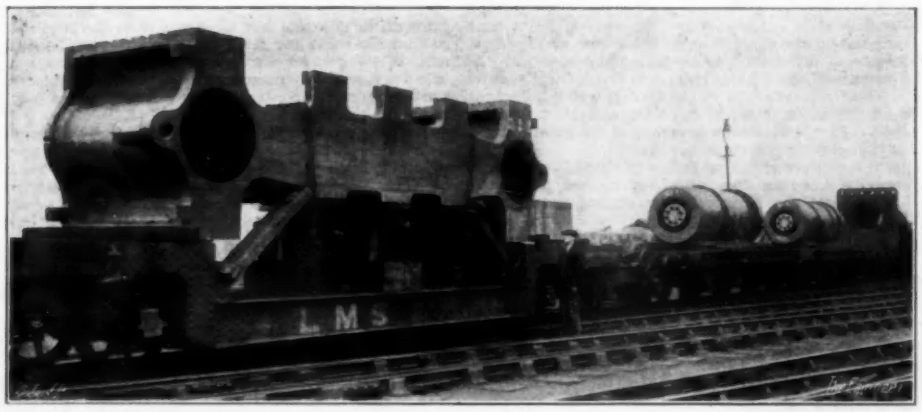
There are given above, tests upon three similar engines with bores 70 mm., 110 mm. and 130 mm., the stroke/bore ratios being, respectively, 1·71 mm., 1·45 mm., 1·38 mm. The corresponding outputs per litre of swept volume are 16·7, 13·1, and 12·14 H.P. It would appear, therefore, that, within the ranges of speed investigated, neither speed of revolution nor the rapidity of combustion impose any limits to engines of this design.

As regards engine weights, the six-cylinder engine is about 1440 lb. and thus weighs 12 lb. per brake horse-power; the four-cylinder engine is about 1300 lb., the weight per horse-power being 11·2 lb. per brake horse-power, the engine weights being those given by the firm.

Probably the most striking fact shown by the tests is the exceptional outputs at the higher speeds. Whereas, with most heavy-oil engines, there is a considerable falling off in brake mean pressure between, say, 1000 r.p.m. and 1800 r.p.m., the output characteristics of the Oberhänsli engines may be said to resemble more closely those of petrol engines. This is an important point when the designs of transmission gear in vehicles have to be taken into account.

An Interesting Train Load.

An order was received by Davy Brothers, of Sheffield, some time ago for a 6000-ton "Davy" patented forging press, to be delivered to the Stalingrad works of the Russian Government. The same firm was responsible for the design of a similar press supplied to Russia prior to the war,



Parts of a Forging Press Entrained for Russia

but not completely erected at that time, and the recent contract is for the reconstruction of the press to bring it into accordance with the most modern practice. On this page an illustration shows a train load of parts of the press ready to start from Sheffield for Russia, *viâ* Hull. The English Steel Corporation manufactured all the castings at its Grimesthorpe works. Included in the train load there are a large base plate girder, weighing over 60 tons, and a crosshead stalk weighing about 30 tons. The base plate girder, which measures about 24ft. by 7ft. by 7ft., weighed 68 tons before machining. The total weight of parts on the train was about 215 tons.

Electrification of the Stockholm Malmö Railway and Branch Lines.

When it was decided to electrify the Stockholm-Gothenburg railway in 1923, the estimates were based on totally different conditions from those ruling in 1926, when the line was ready for service. The savings expected could not, therefore, be realised at all points, but it soon became evident that the electrification had resulted in savings in certain spheres. After the line had been working for two years and all its characteristics were known, the auditors of the State Railways considered that the time was ripe to investigate the results. These investigations showed that electrification had fully warranted the capital outlay and that the scheme was distinctly beneficial to the country.

Mainly as a result of these conclusions, the auditors recommended that the State Railway Board should bring forward a proposal to extend electrification, and in June, 1930, it submitted a scheme to the Government for the electrification of the lines Malmö-Trelleborg, Arlöv-Lomma, Katrineholm-Aby, Orebro-Hallsberg-Mjölby, and Falköping-Nassjö, together with a proposal to extend the existing system to Malmö. The question was submitted to the 1930 Parliament, and on February 4th, 1931, the Government decided that the scheme should be put in hand. On February 14th the A.S.E.A. obtained a definite order for the electrical equipment of seventy-five express and goods locomotives, twenty-one shunting locomotives, and eight combined trolley-accumulator locomotives, together with the electrical equipment of six motor generator sub-stations.

In a recent issue of the *A.S.E.A. Journal*, Mr. C. Wijkborn gives the leading particulars of the scheme, together with the cost of the various portions of the equipment, the total estimated cost being £3,900,000, made up as follows:—

	£
Six motor-generator stations	330,000
1000 miles of trolley line	1,220,000
Compensating or boosting lay-out	250,000
High-voltage lines for lighting	120,000
104 locomotives	1,050,000
Electrical heating of the carriages	170,000
Various alterations to the lines, lighting installations, and re-arrangement of the commercial lines	530,000
Transposition of telegraph and telephone lines	230,000
Total	3,900,000

The savings due to the electrification are estimated at:

	£
Reduced staff	123,000
„ coal costs	204,000
„ locomotive maintenance costs	53,000
„ lubrication costs plus decreased maintenance of coal and water stations	18,000
„ lighting costs	10,000
„ cost for goods wagons and tarpaulins	2,000
„ maintenance of telephone and telegraph lines	6,000
Total	416,000

The increased costs are:

	£
Interest on the new outlay	121,000
Interest on charges for the telegraph lines	10,000
Maintenance and care of motor-generator sub-stations	65,000
Power consumption	151,000
Total	347,000
Estimated saving	£69,000

The calculations of the Railway Board, based on the experience gained on the Stockholm-Gothenburg line, indicate that an increased income of about £55,000 is to be expected from the scheme. The six motor-generator sub-stations will be erected at Malmö, Hässleholm, Alvesta, Nässjo, Mjölby, Eksund and Hallsberg, and will be approximately 62½ miles apart. Of these six sub-stations, those at Malmö, Hässleholm, Alvesta and Nässjo will be fed from the Sydsvenska Kraft Aktiebolagt's three-phase distribution lines, whilst the others will be fed from the lines of the Royal Board of Waterfalls. Three converter sets with a total continuous output will be erected at Malmö, Nässjo, Mjölby and Eksund, and two sets at the other sub-stations. The 50-cycle, three-phase current will be converted into single-phase current at 3000 volts, 16⅔ cycles, and the pressure will be transformed up to 16,000 volts for the overhead trolley lines, which are to be similar to those on the Stockholm-Gothenburg railway, with sectionalisation between sub-stations, which will not, therefore, work in parallel on the single-phase side. The copper trolley wire will have a section of 80 square millimetres, the messenger wire 50 square millimetres, and the return wire, with series compensating transformers, 130 square millimetres. With this system of compensation and with the telegraph and telephone lines in cables with earthed lead sheaths, all possibilities of disturbances in the communication circuits will be avoided.

The 1–C–1 passenger and goods locomotives will be the same as those used on the Stockholm-Gothenburg line, and will be capable of hauling a 550-ton train at a maximum speed of 62½ miles per hour, or a 900-ton train at 47 miles per hour.

For shunting purposes the 0–C–0 type of engine will be used, and will be capable of hauling a 600-ton train. This type of engine has only one motor, with an output equal to that of one of the motors on the 1–C–1 locomotives. The combined trolley and accumulator engines, which can be operated either from the overhead lines or from the batteries, are intended for erection purposes and for places where there are no overhead lines. The motors are axle suspended D.C. tramway machines, and the battery will be charged through suitable converting equipment from the overhead lines.

South African Engineering Notes.

Victoria Falls Power Company.

The electrical demands by consumers on the power stations of the Victoria Falls and Transvaal Power Company is now 216,000 kW, and the demand for power in the form of compressed air is 48,000 kW. To drive this installation of electric and compressed air plant involves the purchase of roughly 2,000,000 tons of coal annually. The weight of the compressed air delivered to consumers is also 2,000,000 tons per annum. During the past year the load and the additional orders for power still required have increased considerably, while further probable demands have been forecast as likely to become definite requirements in the future. To meet these increases of business a further large extension programme is now in hand comprising two large generating sets of 32,500 kW each, with boilers and boiler-houses for the same; a new transmission line from Vereeniging to the Eastern Rand, together with the necessary transformers and switchgear at distribution stations and consumers' sub-stations. All this plant will be supplied by British manufacturers. The two large turbine generators which formed the principal part of the last extension programme, one of 32,500 kW at Vereeniging and one of 20,000 kW at Brakpan, have been in commission for some time and the new electrically driven air station at Canada Dam will start later in the year.

New Bridge Over Gouritz.

With the opening of the Gouritz River bridge on August 1st, the Cape Town-Mossel Bay section of the Cape Western railway system is raised to the standard of a main line. Ever since the South African Railway Administration took over the line from the New Cape Central Railway Company in 1925, operations have been in progress to fit the section to take the same axle loads as are carried over the other main lines of the Union. This work entailed the strengthening or replacement of practically all the culverts and bridges on the section, and the relaying of the track. All this work was completed some time ago, with the sole exception of the erection of a stronger bridge over the Gouritz River, as the existing one, in spite of frequent alterations, could not be improved sufficiently to take main line engines, as at present in use, running at speed. The new bridge has a total span of 770ft., with the rail level 210ft. above the level of the river bed, and is well able to carry the heavy main line engines. The total weight of the steel work used in the construction of the bridge aggregated a little over 1500 tons.

Main Line Electrification.

Another big step forward in the electrification of the main line between Maritzburg and Cato Ridge (Natal) was accomplished recently, when more than a hundred masts for the carrying of the overland gear were erected between Mason's Mill and the Atlas Brickworks. As a result of the lessons learned from the original electrification scheme the work of setting up the masts is now being carried out at less than a quarter the cost of the corresponding work on the Maritzburg-Glencoe section, and without the engagement of any extra staff. The cumbersome concrete foundations of the original scheme, weighing about 10 tons a piece, have been discarded in favour of two concrete "sleepers" which weigh only about three-quarters of a ton, while strong and effective masts have been manufactured by the simple process of welding two old rails together by means of short steel cross pieces, so as to give the effect of a narrow ladder. The masts themselves have been entirely constructed in the Maritzburg workshops, while the concrete blocks have been precast in Durban. It is anticipated that electric trains should be operating over the section about the end of this year.

Kimberley Aerodrome.

A number of the large cities of the Union are now engaged in constructing landing grounds and hangars for the air services which are being provided. At Germiston a very large aerodrome has been constructed, and will be the main terminus for the Imperial Air Service, which is to be established and will commence operations in January next. The extreme end of the flight from Britain will be at Cape Town, which has, for some time, had its aerodrome ready for the purpose. Other centres which have, or are preparing, landing grounds, hangars, &c., are Durban, East London, Bloemfontein, Port Elizabeth and Kimberley. Gilbert Hamer and Co., Ltd., structural engineers, Congella, Durban, have obtained the order for the Kimberley aerodrome. The hangar is 150ft. long and 110ft. wide, with a clear door height of 30ft. There is an annexe 30ft. by 20ft., by 10ft. high at the eaves, the whole structure complying with the requirements of the Director of Civil Aviation.

Smoke Abatement.—The National Smoke Abatement Society has just issued a "Smoke Abatement Handbook," which is designed primarily to give all those who are interested in smoke abatement and who may be called upon to speak or write upon it, a quantity of up-to-date information on all aspects of the problem that hitherto has not been available in small compass and in one publication. The Handbook—a 50-page pamphlet in paper covers—is sold at 6d. a copy post free, and may be obtained from the National Smoke Abatement Society, 23, King-street, Manchester.

A New Chaser Die Stock.—A new form of pipe-threading tool, of British manufacture, has just been put on the market by Mosers Ltd., of 4, Marshalsea-road, and Borough High-street, London, S.E. 1. It has four cutting dies, which are adjusted to the diameter of the pipe by a cam plate and indicating dial, which is graduated for standard sizes. Full, or slack, threads can, however, also be cut, and, on account of the long gradual taper of the dies, it is unnecessary to file the tube before cutting the thread. A full thread can be cut in one operation, and the dies then released, by simply pressing a knob for the removal of the tool. There is a ratchet motion between the dies and the handles, which can be set to work in either direction, or the stock can be had without ratchets.

Vibration and its Isolation.

Engineers are, of course, familiar with the two alternatives of bolting down machinery to such massive foundations that its vibration is practically damped out, and the other of mounting it on a spring cushion, so as to absorb the vibrations, but the proportions involved in carrying out either one or the other scheme have seldom been estimated on an exact mathematical basis. With the help, however, of a vibrograph instrument made by the Cambridge Instrument Company, Mr. Grey, of W. Christie and Grey, Ltd., 4, Lloyd's-avenue, has succeeded in reducing the matter to a fine art and has produced such results

Figs. 1 and 2—Vibrograms

as that indicated by the two charts reproduced in Figs. 1 and 2.

These charts show, first, in Fig. 1, the vibrations of an oil engine bed-plate, which were causing annoyance. After a study of several such graphs, it was suggested that the arrangement of the cranks should be altered and the graph shown in Fig. 2 was obtained. The amplitude of the vibrations had been reduced from 0·22 mm. to 0·015 mm., and the frequency from 9·75 per second to 2·5 per second. It will be seen that a very great improvement had been made, and in this connection it may be pointed out that a vibration having an amplitude of 0·015 mm. and a periodicity of 3·3 per second can be described as only tolerable, while the same vibration with a periodicity of 9·75 per second is a distinct nuisance.

In the case just mentioned a definite cure was effected, but there are instances in which it is impractical to eliminate vibration from machinery and then the machine must be isolated from its surroundings. In the past efforts were made to meet such cases by putting a fibre mat, a felt, or a rubber pad, under the base of the machine, but these arrangements were rarely completely effective. For one thing, it is very difficult to make any adjustments after the installation, to meet conditions which only become apparent when the machine is under load.

In order to obtain any degree of success with this method of isolation, a considerable amount of experience is essential. Due regard must be given to the unbalanced forces of the engine and the foundation proportioned accordingly, some knowledge of the subsoil conditions is also necessary, and this must be obtained by putting down a bore-hole to a suitable depth. In addition to this, the natural frequency of the whole system supported upon the resilient isolating layer must be considered relatively to any frequency of the engine. Should there be resonance between the engine and the system as a whole, then vibration will, of course, be amplified.

The most generally applied material for isolating by this method is selected natural cork, cut up into rectangular blocks, compressed and bound round by steel frames. The sizes of the frames are made to suit the requirements of the foundation, as shown in Fig. 3, the maximum individual frame being 6ft. by 3ft. The thickness also varies from 1½in. to 3in., according to the frequency. The useful range is, however, governed by the elasticity and bearing capacity of the cork. Its application has met with considerable success when proper regard has been given to the governing factors mentioned above.

A great improvement has recently been effected in isolated foundation design by the invention by Mr. Grey of a foundation block isolated on springs. This block can be designed to have any predetermined frequency and can be adjusted whilst the machine is running to meet the conditions which not until then usually make themselves apparent. As applied to oil engines, it consists

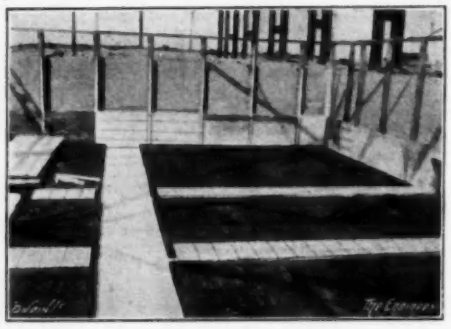


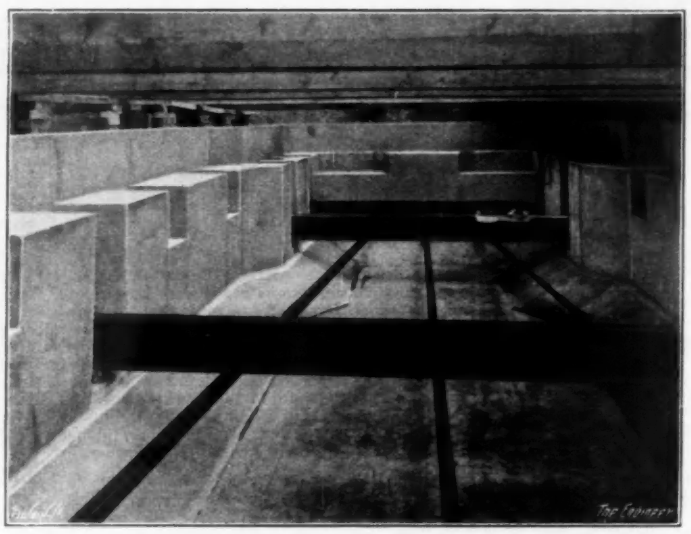
Fig. 3—Cork Isolation

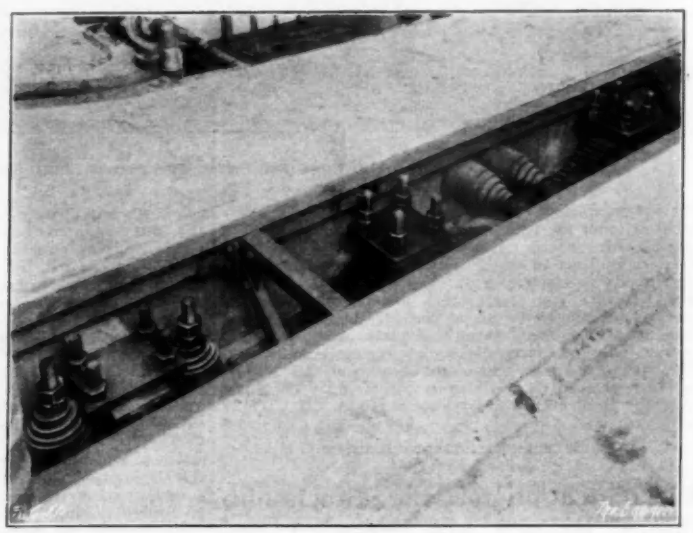
of a combined raft and outer shell, as shown in Fig. 4, and the main foundation block to which the engine is fixed.

The main foundation block has a number of joists embedded in the concrete, the ends of which project beyond the sides of the block and register with recesses cast in the outer shell. Some of these joists are seen in position in the illustration, prior to the main foundation block being cast round them. The joists are at varying levels, and the ends are attached to tension bolts which transfer the weight to laminated springs bridged across the recesses. By taking the weight on the tension bolts, the main foundation is lifted about 2in. clear of the lower raft, and is thus suspended by the tension bolts from the laminated springs. These bolts are arranged as pendulums of different lengths to avoid resonance. At each corner of the block, bolts are fixed in the outer shell. These pass through volute springs which bear upon joists in the main foundation block, and by tightening up these bolts the vertical movement of the main foundation is brought completely under control.

Volute springs with screw jack adjustments are placed horizontally between the main foundation and outer shell to control the horizontal movement, as shown in Fig. 5. This control is a very important feature in this type of foundation as it enables the movement to be adjusted to the point of minimum transmission. Vibrograph records taken on and around a foundation of this type show that there is a critical point of adjustment which produces the best results.

It is, of course, equally feasible to isolate delicate recording instruments and other apparatus from vibrations that may be transmitted to them from the outside.

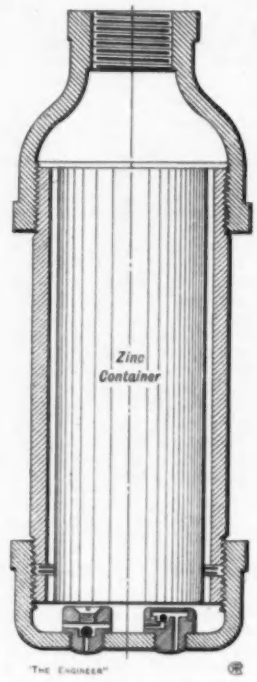




Figs. 4 and 5—Spring Suspension Isolation System

A Silica Gel Transformer Breather.

From Silica Gel, Ltd., of Bush House, Aldwych, we have received particulars of a Silica Gel breather for transformers, which has been designed to replace those employing calcium chloride. The breather can be made for all capacities and can also be applied to joint boxes and oil transport and storage tanks. The apparatus is of simple and robust construction, the main body being composed of steam pipe with a malleable cast iron reducing socket for connection to the transformer, and a malleable cast iron base in which inlet and outlet ball valves are housed, as shown in the accompanying section. An essential



Silica Gel Breather

feature of the breather is an inner zinc container with press-on lids to seal the silica gel from the atmosphere, so that the container can be kept in store until such time as it is required for service. When the apparatus is put into use it is merely necessary to unscrew the base, remove the lids from the container, insert it in the breather, and screw up the base.

The provision of the inlet and outlet ball valves at the base of the apparatus ensures that when breathing takes place the whole of the air must pass through the mass of silica gel, which is a chemically prepared product of uniform quality and consists of silicon dioxide in a colloidal form and is chemically inert. It is said entirely to obviate all corrosion difficulties which arise when the usual chemical absorbents are employed, for when silica gel is entirely saturated with moisture it remains externally dry. Given the amount of breathing per day, it is possible to design the silica gel breather to give sufficient dehydration for a definite period, a matter, the makers point out, which constitutes a considerable advantage in the case of transformers installed in underground pits or other awkward places, as it obviates frequent inspections.

Breathers may be designed to give efficient dehydration for any length of time. At the end of the period for which efficient dehydration is guaranteed it is necessary to renew the charge, which can very easily be done by keeping a supply of spare containers. The saturated charges may be re-activated at some central depôt, or they may be sent to the makers of the apparatus. To

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Speaking recently, Mr. C. Grasemann, the Public Relations and Advertising Officer of the Southern Railway, said that 80 per cent. of that company's advertising expenditure was spent in the Press.

meet the requirements of those who require a breather of better finish than the one described, the apparatus is also made in brass.

A LARGE ELECTRIC LOCOMOTIVE.

A 3600 H.P. electric locomotive has recently been completed, and designed to run in express passenger service from Irun to Alsusua, the Norte Railway of Spain, at speeds up to 110 kiloms. (68·35 miles) per hour. The electrical equipment was designed, and a considerable part of it made, by the Metropolitan-Vickers Electrical Company, while the remainder of the electrical equipment and all the mechanical parts of the locomotive were made at the Reinosa works of the Sociedad Espanola de Construccion Naval.

The locomotive, which is of the 4–6+6–4 type, weighing about 150 tons, consists of two main trucks connected by an articulated coupling. The body, which terminates at the fronts of the driver's cabs, is separate from the trucks, and rests on the usual pivot centres and bearers. Each of the trucks has three driving axles and a standard Norte Railway guiding bogie truck. Each of the six driving axles is driven by two motors, which are rigidly mounted on the top of the trucks, and employ the Winterthur universal type of drive. The motors have a 1-hour B.E.S.A. rating of 320 H.P., as determined on test. The control gear is of the Metropolitan-Vickers electro-pneumatic unit switch type, arranged for 1500-volt D.C. supply. Provision is made for series, series-parallel and parallel motoring connections, each with field control steps, giving in all nine economical speed combinations. Regenerative control for operation on down grades is also provided, separate excitation of the motor fields for this purpose being obtained from a motor generator set situated under one of the end covers.

The rating and weight of the new Norte Railway locomotive, viz., 3600 H.P. and 150 tons, may be compared with the corresponding values for other notable electric locomotives, viz., G.I.P. Railway freight locomotives, 2600 H.P., 120 tons; G.I.P. Railway passenger locomotives, 2160 H.P., 100 tons; and South African Railways locomotives, 1200 H.P., 69 tons.

DIAMOND JUBILEE OF AN ELECTRICAL ENGINEERING FIRM.

A business was established in 1871 by James Edward Paterson at Bedford-court, Covent Garden, and for several years was carried on at that address, but later, at Little Britain, Aldersgate-street, for the making and selling of electric bells, indicators, batteries, &c., combined with experimental apparatus, meters, philosophical instruments and appliances for educational purposes. Though Mr. Paterson was particularly interested in lighter work of this kind, he foresaw the great part that heavy electrical engineering must play in the future. Accordingly he took into partnership Mr. Charles F. Cooper, a trained mechanical engineer, who had served his pupilage with Gwynne, of Hammersmith. With the advent of Mr. Cooper, the European Telegraph Works at Dalston, previously acquired, were equipped with the power and machine tools necessary for the manufacture of dynamos and other heavy electrical plant, and the firm of Paterson and Cooper soon became known throughout the world as makers of most appliances required in the electrical industry. Hundreds of permanent magnet ammeters and voltmeters designed by Ayrton and Perry were turned out by the firm. Ohmmeters and watt-meters followed, and when the Cardew voltmeter appeared the firm took up its manufacture and disposed of large numbers. Invention was rife in those days, and in addition to the usual routine at European Works, there was always plenty of work of a novel character going on. Amongst things which evoked considerable interest, for example, was the series A.C. system of Gaulard and Gibbs, the transformers for which were constructed at Dalston.

In the autumn of 1883, Mr. W. B. Esson joined the firm as chief electrician, becoming manager twelve months later, and in 1885 Mr. W. R. Saltrick, joined as a lad and has remained with the firm ever since, being the general manager of the present company. At that time dynamo designing was in a very experimental stage, and several strange types were in being. Most of the designs had been of a flimsy character and the firm had made a start with some machines designed by Ayrton and Perry which had not proved a success. In 1883 a machine was being constructed under the Elphinston and Vincent Patents, but the type was eventually abandoned in favour of the "Lumley" machine, from which was developed in due course the "Phœnix" dynamo, which earned a world-wide reputation.

In the days when arc lighting was at its height, the making of arc lamps and apparatus connected therewith formed a large part of the business. Amongst others, there were made at different times the "Foxcroft," the "Pilsen," the "Clark-Bowman," and the "Phœnix" lamps, and many contracts were undertaken for the complete lighting by both arc and incandescent lamps of shipyards, weaving sheds, flour mills, paper mills, printing works, breweries and other industrial undertakings.

In the middle 'nineties the firm got into difficulties owing to the failure of the Hermite process of bleaching by electricity. Like many other electro-chemical ventures, the system promised success when on a laboratory scale, but on the "grand" scale it proved a commercial failure, and Paterson and Cooper had spent large sums of money in bringing it thus far. It was at this stage—in May, 1897,—that Mr. William Geipel joined in partnership the late Mr. F. M. T. Lange, and together they acquired the contracting and agency departments of the business, which they continued under the new firm of Geipel and Lange at Paterson and Cooper's offices, 68, Victoria-street, and later in Parliament Mansions Westminster. Mr. Geipel brought into the firm the steam trap he had invented shortly before.

In the early part of the present century the firm began its gradual return to the ranks of electrical manufacturers, until to-day, again its main interests lie in manufacturing just as they did sixty years ago. In 1903 a move was made to St. Thomas's-street, in the Borough, where suitable factory premises had been obtained, and the firm began to make switchboards and motor starters. In 1906, Mr. Lange retired from the partnership, and the firm was carried on by Mr. Geipel under the name of Wm. Geipel and Co. In 1914 a decision was taken which considerably influenced the future of the business. The firm had been merchandising electric cables for some years, and it was then decided to put down a plant of its own for the manufacture of vulcanised india-rubber wires and cables. A site was accordingly acquired at Alperton, near Wembley, in Middlesex, and factory premises were built and equipped.

Four years ago, the works and departments in St. Thomas's-street were moved into the premises now occupied at 156–170, Bermondsey-street, and the business was formed into a private company, registered under the name of William Geipel, Ltd.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Marking Time.

In Midland and Staffordshire iron and steel and engineering circles, it is fully realised that any movement towards trade revival cannot be expected until after the General Election, and consequently business "hangs fire" and industry "marks time." The cheerful market tone of recent weeks persists, and there is an air of expectancy and confidence. Industrialists are disposed to believe that the country will make known in no uncertain measure its determination to secure its future as a trading nation. Industry is likely to play a greater part in the coming election than it has ever done before. Either industry must flourish or the country decline. The past week has brought practically no change in the conditions ruling in the iron and steel and engineering trades in this area, and transactions in materials have been few.

Steel.

The market for finished steel remains dull, and mills in this district find it difficult to carry on, owing to the lack of demand from the structural engineering trade. Though in some quarters orders have been more plentiful, specifications continue scarce. Generally, there is a disinclination to speculate on the future. Little movement in the heavy steel industry is expected before the country settles down again after the election. The Steel Masters' Association has made no alteration to the selling rates of controlled material, and quotations are as given last week. Boiler plates which are not subject to control are named £8 17s. 6d. The semi-finished branch of the steel trade is very unsettled, and it is obvious that it will be some little time before the position clarifies and regular trading is resumed. On the lower basis of sterling native steel is in a less disadvantageous position than it was, and, further, the prospect of a change in the nation's fiscal policy gives rise to hopes of a further move towards equality of British and foreign steel prices. District steelmasters, temporarily relieved of foreign competition, have advanced quotations considerably. All-British steel bars have risen to £8 per ton, while small bars re-rolled from continental material are upwards of £6 12s. 6d. Billet makers want from £5 5s. to £5 10s. for mild steel billets. There has been no rush to secure supplies, buyers exercising considerable caution. Producing works hereabouts are, however, in a little better position, as a result of the confused state of the market. Imports are coming in against contracts made before the new situation developed, but very little new business is being given out. Steel scrap was on offer in Birmingham this week at about 30s. This is claimed to be an improvement of some 5s. per ton on recent prices. There are very few buyers.

Manufactured Iron.

Business in all branches of the finished iron trade is on a very limited scale. Some consumers at last week's quarterly meeting took the opportunity to safeguard themselves against any shortage of supplies, but it was obvious that the orders placed were of a precautionary character. There is no increase in consumptive demand. Staffordshire ironmasters find it difficult to keep the mills at work, and activity is uneven and irregular. Attention has this week been drawn to the common bar branch in which foreign competitors have again entered the market. Belgian firms offer No. 3 iron to the nut and bolt manufacturers at a figure little more than half the price quoted by South Staffordshire makers of competing bars. A few small orders which under ordinary conditions would have gone abroad, have during the past fortnight been placed with Staffordshire firms, but now that Belgium has made known her selling rates, hopes of securing additional business have waned. Staffordshire makers maintain their quotation for nut and bolt and fencing bars, at £8 7s. 6d. per ton. Best grade iron sells in small quantities at £12 per ton at makers' works. If anything, there is a slight advance in the call for this material. Crown bars of Staffordshire make are quoted round about £9 15s. to £10, but supplies from other districts are offered on the Birmingham market at £9 5s. Orders for wrought iron tube strip have so increased that some of the mills have now substantial order books. Though not all the mills in the district are so well placed, values remain firm at £10 10s. to £10 12s. 6d. per ton delivered.

Pig Iron.

Quiet conditions have ruled throughout the week in the pig iron market. Further sales of foundry and forge pig irons were conducted at the quarterly meeting, but since then there has been little business to be had. Users of raw iron have in many cases covered themselves until the end of the year, and except for a number of small tonnage orders little activity in this department of the market is anticipated before the New Year. It is said that contracts running well into next year have been offered, but the tendency is for furnacemen to refuse long-date contracts. Their production costs have already risen, and may advance still further, in which case smelters will want better prices for their iron. Quotations this week show no change, Derbyshire forge being £3 1s., No. 3 foundry £3 6s., Northamptonshire forge £2 17s. 6d., No. 3 foundry £3 2s. 6d., North Staffordshire forge £3 1s., No. 3 foundry £3 6s., all per ton delivered at stations in the Black Country and subject to graduated rebate. Producers of hematite have strengthened their position and sales continue to be made at the higher rate now ruling.

Galvanised Sheets.

Local galvanised sheet mills are now more fully occupied than they were, and prospects for the industry are considered to be brighter than they have been for some time past. Overseas business is still expanding, and tonnages are heavier. An increasing number of makers are asking higher prices for their output, but the market level does not appear to have advanced beyond the basis of £9 15s. per ton f.o.b. for 24 gauge corrugated sheets. Home demand is quiet, and this remark applies also to the business in black sheets. There has been an appreciable increase in the price of tin-plates, and there is reported to be prospects of increased output from South Wales in the near future.

Overseas Trade.

Midland manufacturers derive but little comfort from the Board of Trade returns for September. They show some improvement on the previous month, both exports and imports having increased in value. The Bank Holiday in August would contribute to this result, but it is doubtful if the extra working days are entirely responsible for the improvement. The month's imports of £68,317,926 were an advance of £3,056,840 on those of August, and compare with £78,589,443 in September, 1930. Exports valued at £29,846,057 showed an advance on August figures of £709,142, but compared very unfavourably with the figure of £42,740,637 in the corresponding month last year. Unfortunately for this district, the bulk of the month's decline in exports compared with September last year was in articles wholly or mainly manufactured. Iron and steel manufactures fell in value by £1,248,494.

Foreign Metal Pipes.

Birmingham is very interested in the recent growth of imports of iron and steel flush pipes, and a group of makers of these pipes, members of the Birmingham Chamber of Commerce and the Associated Builders' Merchants, Ltd., on the 12th inst., supported an application for the making of a marking order in respect of iron or steel flush pipes, whether galvanised or not, before the Board of Trade Committee. It was claimed that this trade originated in England, and that the competition from abroad was largely of recent origin. The pipes made were mainly for export to this country. They asked that imported pipes should bear an indication of their place of origin.

Obituary.

I regret to have to record the death on the 8th inst. of Mr. Harry Maze Jenks, of Wolverhampton. All his life he had been intimately connected with the iron and steel trade, being a member of the Birmingham Iron and Steel Exchange. He succeeded his father in the firm of J. and H. M. Jenks, Ltd., and at the time of his death he was chairman of directors. He was also one of the fairly early pioneers in the film industry.

Unemployment.

Employment in the Midlands area continues erratic, and the increase of 20,000 odd recorded last week has been followed by a decrease of over 25,000. The present total of 392,774 is 106,000 higher than it was a year ago and includes 276,312 wholly unemployed. Of the grand total, 270,816 are men, 104,946 women, 9247 boys and 7765 girls. The number of unemployed in the Birmingham area is 74,294, as against 74,872 a week ago. A decrease of some hundreds in the Stoke-on-Trent area has brought the figures down to 34,299. The towns showing increases on the week are Bilston, Dudley, Oldbury, Peterborough, Redditch, Stourbridge, and Brierley Hill, Tipton, and Wolverhampton.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Overseas Markets for Textile Machinery.

Although British exports of textile machinery last month were well below the value of shipments in September, 1930, there is some satisfaction to be derived from the fact that they were slightly above the average for the nine months of this year from the point of view of value, and more so regarded solely from the point of view of tonnage. Last month's exports amounted to 5154 tons, valued at £440,711, and included 3721 tons of spinning and twisting machinery, valued at £316,348, and 995 tons of weaving machinery, valued at £73,864. The September total compares with 5539 tons and £527,915 in the corresponding period of last year, while for the nine months the exports were 38,779 tons and £3,867,402, and 72,410 tons and £6,892,869 in 1931 and 1930 respectively. British India heads the list of markets for British textile machinery with takings valued at £132,543, followed by Japan with £44,089, China £38,512, France £35,311, Germany £27,454, the Netherlands £19,302, the United States £13,352, South American countries £11,588, Australia £6932, and Russia £3140, "other European countries" accounting for aggregate shipments valued at £56,608. Germany, China and Japan were the only individual markets to show slight increases compared with September of last year.

Textile Machinery Exhibition.

The Textile Machinery and Accessories Exhibition to be held at the City Hall, Manchester, from November 18th to 28th, is expected to house a representative display of spinning, winding, weaving, reeling, doubling, knitting, sewing and other types of textile machinery, as well as representative exhibits of steam and power-saving appliances.

Stainless Steel Tanks.

An interesting development in the manufacture of stainless steel tanks and piping is being undertaken by a well-known Lancashire firm of constructional engineers—John Booth and Sons, of the Hulton Steel Works, Bolton. According to Mr. Harry Booth, a member of the firm, they have succeeded by means of a new process of welding in producing tanks of stainless steel that give the requisite smoothness for use in the brewing, chemical

and dairy farming industries, in which glass tanks have hitherto largely been employed. The difficulty of having to use rivets has, therefore, been overcome. Plans have been completed for the large-scale production of tanks and piping, and already numerous special inquiries are being handled.

Aeroplanes for the Argentine.

The construction of six aeroplanes, part of the order for fifteen placed recently by the Argentine Government, has been completed by A. V. Roe, Ltd., Manchester, and satisfactory tests have been carried out on behalf of the Argentine Air Force. The makers were well represented at the Buenos Aires Exhibition last spring, and the order in question was one of the results.

A Seven-mile Steel Wire Rope.

What is claimed to be the longest steel wire rope ever made has just been manufactured by the Whitecross Company, Ltd., of Milner-street, Warrington, for use on the Glasgow Subway Railway, transport from Warrington to Glasgow having been effected this week. The rope is 4¼in. in circumference, 7 miles in length, and 56½ tons in weight, and the process of manufacture occupied about two months.

Non-ferrous Metals.

Following upon the more or less serious reaction in all sections of the non-ferrous metals markets, with the exception of tin, reported a week ago, there has been a general upward movement, and although lead is not yet back to the highest point touched since the departure from the gold standard last month, tin, copper and spelter have all gone beyond it. Stocks of tin in this country are still formidable, but the process of reduction goes steadily on, and with buying interest in the metal more active, there has been an advance on the week of nearly £7 per ton. Apart from a spurt in purely speculative buying operations, there has been no improvement in the demand for copper; but, largely on the strength of American influences, prices of standard brands are higher on balance by about £2 10s. per ton. Lead has recovered about half of the previous week's loss, current quotations being 15s. per ton higher, and during the last few days buyers have displayed renewed activity. Home consumers of spelter, more especially in the galvanising industry, are better employed, and, partly on this account, but partly, also, in sympathy with other sections of the markets, values have moved up to the extent of about £1 per ton.

Iron and Steel.

The tone of the iron and steel markets here continues to be rather more cheerful. Following upon the recent improved buying movement in pig iron sales have fallen off, but makers are taking the philosophic view that they cannot cover users' needs twice over. What they are more concerned about now is the rate at which the iron will be taken into consumption. There is plenty of room for improvement in the position of Lancashire jobbing foundries and in the textile machinery industry, which, normally, are responsible for a very heavy tonnage of pig iron, but, in one or two other directions, foundry operations are on a somewhat better scale, and with competition from machinery scrap likely to diminish rather than to increase, the probability is that a bigger aggregate quantity of iron will be called for. Prices are maintained at 67s. per ton for Derbyshire, Staffordshire and Cleveland makes, 65s. 6d. for Northamptonshire, about 87s. for Scottish, and 81s. for West Coast hematite, all for delivery equal to Manchester. Slightly more business is reported in certain sections of the steel market, without, however, constructional engineers in the district contributing much in this respect. Rollers still complain regarding the difficulties of making up rolling programmes and they are pressing for specifications. Few steel makers at the present time seem to be anxious to contract very far ahead. In the meantime, joists are quoted at £8 15s. per ton, sections at £8 7s. 6d., large diameter bars at £9 7s. 6d., tank plates at £8 17s. 6d., small re-rolled bars at £7, and boiler plates at about £8 15s. Sellers of continental materials on this market are booking small orders for finished products.

BARROW-IN-FURNESS.

Hematite.

The slightly improved tone in the hematite pig iron market is maintained, and now that the rail departments at the Barrow Steel Company are at work, the local demand for iron is making it possible for the stocks to be reduced. There is a better tendency to buy iron on the part of home consumers, who are, no doubt, keen to get in while prices rule low. Up to the present there have not been many big orders for overseas, but this side of the market may develop. Altogether, there seems to be a better feeling. The furnace at Backbarrow, which, at one time, was the only charcoal furnace in the country, but has, in recent years, discarded the old methods and now produces a high grade malleable iron, has restarted. This is not due to the condition of exchange, but to clearance of stocks and a bigger home demand. Iron ore is experiencing a rather better market, but there is any amount of room for expansion yet. The steel trade is quiet, and it is hoped that further contracts will come along to keep the Workington and Barrow rail departments going for some time. Orders held at present will not take them far. Hoops and small sections are being rolled at Barrow and the outlook is fair.

SHEFFIELD.

(From our own Correspondent.)

Ups and Downs.

THERE are some changes to report in the local trade situation this week, but not all of them are on the right side. While some branches are benefiting from the altered financial conditions of the country, others seem to be still losing ground, and, on the whole, the output of the city shows little alteration. At the same time, there is a feeling of confidence about, and it is felt that an improvement is likely after the General Election, the holding of which is, as usual, having an unsettling effect. Some buying of certain descriptions of steel is reported, consumers having shown a desire to cover their requirements for two or three months in advance. Little progress is to be found on the export side, however, and producers of the best tool steels, in particular, report that their foreign customers are not buying on an increased scale. The market for iron and steel material is hardening, while that for scrap is decidedly firmer. Scrap users are more inclined than they have been to lay in stocks for future consumption and to pay more. Sellers are now suggesting 40s. per ton as a fair price for basic scrap delivered locally, while buyers are offering about 37s. 6d. Only a fortnight ago the quotation was down to 32s. 6d.

Departmental Items.

There are numerous inquiries about, but not much new business has materialised up to the present. The output of open-hearth steel remains very low, and there is much shortage of work in the heavy manufacturing departments. The call for railway and shipbuilding steel, especially, remains at a regrettably low level. One branch which shows a welcome improvement is that of wire rods. Local works have booked a large tonnage of orders in anticipation of a tariff on foreign rods, which have been largely imported for a considerable time. There is a fair amount of work in those departments which cater for the requirements of the automobile builders, while activity is well maintained in stainless steel and kindred products.

Steel Works Plant for Russia.

One of the largest engineering contracts on hand in Sheffield at present is being executed for the Russian Government, and consists of a 6000-ton "Davy" patented forging press for the Stalingrad Works. The press was designed by Davy Bros., Ltd., of Park Ironworks, and was partly built prior to the war. It is now being reconstructed on the most modern lines, and several massive parts—the order for which had also been executed by Messrs. Davy Bros.—were despatched last week-end. The English Steel Corporation, Ltd., has manufactured all the castings at its Grimesthorpe Works, Sheffield, and those included in the train load just sent away were a large base-plate girder, weighing over 60 tons, and a cross-head stalk, weighing about 30 tons. The largest casting, the base-plate girder, measures about 24ft. by 7ft. by 7ft. Two main pressure cylinders, each weighing about 26 tons, were also included in the consignment, the steel forgings for which were supplied by Thos. Firth and John Brown, Ltd. Messrs. Davy Bros. are also at present building for the Russian Government six forging manipulators to the Alliance Machine Company's designs. The manipulators, which comprise one 10-ton, three 5-ton, and two 3-ton sizes, are intended for the important new plant now being erected in Russia.

Big Contract for Railway Depot.

The L.N.E.R. Company is carrying out large extensions of its depôt at March, Cambridgeshire, which is its centre for goods traffic between East Anglia and the North, where wagons are sorted out on arrival and made up into fresh trains. The company has already completed a new yard for dealing with up traffic, and now it is to embark on a similar scheme for down traffic. In connection with this development, a large contract for sheds and sidings has been placed with Abbott and Bannister, Ltd., of Sheffield, who will proceed immediately with work that will take the greater part of a year to complete. The scheme includes the construction of new sidings and a new locomotive depôt, involving duplication of the existing marshalling sidings. The new down sidings will have accommodation for 160 wagons in the reception section. No fewer than eleven marshalling sidings are to be provided, capable of holding 930 wagons, while three great transhipsheds will accommodate 200 wagons, and 70 more will be provided for on independent tracks. The present engine shed is to be enlarged so as to hold 200 locomotives. Additional cleaning and repair sheds have also been designed. Altogether the clearing depôt is to have about 50 miles of track.

A Large Signalling Scheme.

Another railway matter of unusual interest is the installation of automatic and controlled searchlight and colour light signals on the railway between York and Northallerton, which is to be carried out for the L.N.E.R. Company by the British Power Railway Signal Company, Ltd. The contract is the largest one for signalling that has been given out for many years. Included in the scheme will be 200 searchlight signals, 150 single-aspect signals for worker lights and calling-on signals, 100 banner type shunting signals, 16 route indicators, 10 electric signal mechanisms, and 36 illuminated speed indicators. Five existing boxes at Thirsk will be superseded by one "remote-control" box, and the power-interlocking frame will comprise 115 levers. On the whole length there will be seven electro-mechanical interlocking frames, totalling 225 levers, and the re-locking of four existing frames, totalling 231 levers. There are to be thirteen spot-light illuminated diagrams ranging from 12 to 115 indications; 352 A.C. track circuits, energised from B.P. constant-current transformers, relays being of the double-element vane type, the circuits to have B.P. phase-adjusting devices; 82 power-worked switch lay-outs operated by B.P. point machines; 78 outdoor telephone sets, and twelve indoor telephone sets. Power is being supplied by the York Corporation Electricity Department, and by a local company at Thirsk, which is a subsidiary of the Cleveland undertaking.

A Derbyshire Water Scheme.

For the purpose of increasing the water resources of Chesterfield and Bolsover, it is proposed to develop the Whaley Well, at Bolsover—an undertaking of considerable importance. At a meeting of Chesterfield Town Council last week, it was decided to take steps to promote a Bill jointly with Bolsover Urban Council to obtain powers to lay a water main through the area of the Chesterfield Rural Council from Whaley Well to Chesterfield; for the Bolsover and Chesterfield Councils to supply water in bulk to, and receive water in bulk from, each other, and for the formation of a joint water board. Alderman Wakerley stated that the proposal was a natural sequence to a decision arrived at in January, 1929, to deepen Whaley Well. The well had been tested at a cost of £2000, and the yield, which was previously less than 300,000 gallons per day, had been proved to be 1,200,000 gallons per day. It was proposed to develop the well to its fullest capacity, and when that was done the joint needs of Chesterfield and Bolsover would be ensured until 1952. The total length of pipes to be laid was about 9 miles. The estimated cost of putting the well to full use, including the cost of the mains, was £56,000.

A Yorkshire Sewerage Scheme.

The Rural District Council of Thirsk has adopted a sewerage scheme for Thirsk, Sowerby and South Kilvington. The engineers, Messrs. Balfour, estimate that, exclusive of the cost of land for works and pumping station, the expenditure will amount to £62,000. Application is to be made to the Unemployment Grants Committee to allow the scheme to rank for an equated grant of 63 per cent., and, if this is arranged, steps will be taken for obtaining sanction to a loan.

Cutlery and Plate.

Although the cutlery and plate trades are still, for the most part, very quiet, there has been some improvement, and the outlook seems better. Owing to the fall in the foreign value of sterling, there has been a drop in imports of various kinds of cutlery and razor blades, as well as many kinds of tools. In view of the coming Christmas season, some of the London stores have been buying rather more freely. There is a likelihood of prices of raw materials going up, and consumers are showing a tendency to buy before this happens. Celluloid handles, and nickel silver, are base materials which are sure to cost more in time, but there has been no increase yet, as suppliers hold good stocks which they are selling at the old rates.

NORTH OF ENGLAND.

(From our own Correspondent.)

Northern Trade Brighter.

THE trade outlook in the North of England shows signs of improving in several directions, but particularly in the coal-mining and iron and steel industries. The abandonment of the gold standard is bringing a wave of prosperity to the Northern coal trade the like of which has not been experienced since the war. Old pits are being reopened, new seams are being developed, and work is being found for many hundreds of mine workers who have been unemployed for years. Coalowners are now competing successfully with foreign competitors. The most significant event has been the securing of an order from the West Indies for 2000 tons of Durham coal. It is not a large order, but is regarded as vitally important in that this is the first occasion on which Britain has been able to compete in what has always been regarded as an American market exclusively. The Cowpen Isabella Pit, in the Blyth area, reopened on Monday, providing work for 500 men, and the New Delaval Pit will follow suit shortly. The Ashington Coal Company will open in the course of a few days the lower seam in its Woodburn Pit, which was closed down five months ago. It is hoped shortly to have the pit working at full capacity, thus employing 2300 men instead of the 1500 now working there. Pits in other areas of both Northumberland and Durham are also preparing to restart.

Electrification of Mines.

A contract for one of the most important colliery electrification schemes of recent years on the North-East Coast has been placed by the Ryhope Coal Company, Ltd., of Sunderland, with the General Electric Company, Ltd., of Witton, Birmingham. The scheme covers the north, south, and west pits of the company, each of which will be equipped with an electric winding engine, replacing the original steam winders, while new underground haulages, air compressors, electric cables, and a vast amount of electric control gear, transformers, and other accessories are included. A considerable proportion of the work is being sub-contracted with firms on the North-East Coast, including the pithead gear and the mechanical portions of the haulages, which will be undertaken by Joseph Cook and Sons, of Washington. The whole of the electric equipment will be manufactured in the General Electric Company's works at Witton, with the exception of the cables, which will be made at the company's associated Pirelli-General factory at Southampton. The mechanical portions of the winders will be constructed at the company's Fraser and Chalmers Engineering Works. Some idea of the magnitude of the contract may be gathered from the fact that the total capacity of the motors to be installed will exceed 4500 H.P., of which five, including the winder motors, are of over 500 H.P. capacity, the largest being 875 H.P. The number of flameproof switch panels to be installed underground will total sixty, while above ground there will be over thirty industrial panels. The complete installation is expected to be in operation towards the end of 1932.

Cleveland Iron Trade.

Notwithstanding the disturbing effects of the General Election, the Cleveland pig iron market retains its air of optimism, and a satisfactory volume of business is being done. Although the whole of the output is required for domestic purposes, the restarting of another blast-furnace at the Cargo Fleet Ironworks is regarded

as a favourable sign, and it may not be long before others are lighted up. Cleveland ironmasters are now well sold to the end of the year, and might enter into further commitments if they cared to do so, as consumers are eager to buy ahead. Costs of production, however, are advancing, and in view of this, makers are adopting a policy of caution in regard to forward contracts. The selling price of Cleveland iron in Scotland has been advanced to approximately the same level as the local minima, but the latter remains unchanged. No. 1 Cleveland foundry iron is 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

There is still a substantial demand for East Coast hematite pig iron, both from home and foreign buyers, but makers have deemed it wise not to jeopardise the expansion by rushing up prices, and mixed numbers are still obtainable at 65s. for prompt delivery, though higher prices are asked on forward account. No. 1 quality is at a premium of 6d. per ton.

Iron-making Materials.

There is little business in foreign ore. Best Rubio is quoted at 16s. 6d., c.i.f. Tees. Coke prices are rapidly advancing, and good Durham blast-furnace qualities now range from 17s. to 17s. 6d., delivered at the works.

Manufactured Iron and Steel.

The manufactured iron and steel trade has experienced some small improvement, but except in the sheet trade business is still far from brisk, and prices are unaltered.

A Giant Girder.

Dorman, Long and Co., Ltd., of Middlesbrough, sent from their Britannia Works, Middlesbrough, this week, one of the largest and heaviest girders in the world. Two of the biggest transport wagons in Europe were requisitioned to take it to its destination, the Cumberland Palace Hotel, Hyde Park, London. The girder weighs 98 tons and its dimensions are 78ft. by 10ft. 6in. by 2ft. 6in. Next week a 70-ton girder for the same job will be sent from the Britannia Works.

The Coal Trade.

The Northern coal market is not so active as it was a week ago, and foreign buyers appear inclined to hold off now until the election results point to a steadier political situation. Owners of almost all the favourite grades are well booked up and are also comfortably situated as regards tonnage, especially for this month, and there is no pressure of direct sellers. For November and onwards current full values are asked, but there is no disposition among merchants to commit themselves definitely. The undertone of the market is quite favourable. There is much more trade about for Northumberland steam coals, and collieries are working better than they have done at any time this year. The Southern Counties are taking more fuel, and there is also a larger volume of inquiry from abroad. These new and favourable circumstances are having a beneficial effect on employment. Several colliery undertakings have recently restarted miners, and a number of pits, which have been idle owing to the trade depression, are resuming work. Best Northumberland steams are quoted firm at 14s. to 14s. 3d., with seconds at 12s. to 12s. 3d. Smalls are about 8s. Durham gas coal is heavily booked. Holders quote firmly for this month for the moderate quantities still available. Best qualities are 14s. 6d., and secondary 13s. 6d. Coking qualities are pressed on the market at 13s. to 13s. 6d. There is a moderate inquiry for best unscreened bunker qualities and quotations are on the easy side at 14s. 3d. to 14s. 6d. Secondary qualities are readily obtained at 13s. 3d. The coke position is on the whole firm. Home demand for furnace coke shows signs of expanding. Makers are quoting firmly. For export there is a fairly large volume of inquiry, and although stocks of most brands are plentiful, prices are steadily indicated. Patent oven coke is worth 17s. to 17s. 6d., superior brands 18s. to 21s., and gas coke is steady at 19s.

SCOTLAND.

(From our own Correspondent.)

Quieter Conditions.

Reports of increased inquiries following the suspension of the gold standard have become considerably modified. There is, however, still a strong tendency towards the belief that there will be a gradual increase in trade, especially in the export markets. A fair volume of inquiry remains which may yield considerable business, despite difficult conditions and political changes. Home markets more or less are featureless.

Steel.

So far as heavy steel is concerned, the position is, if anything, slightly worse, and the amount of plant in operation is computed to be not more than 30 per cent. The outlook in the lighter branches, however, has improved by virtue of a considerable increase in the inquiry from overseas, especially from India, China, Japan, and South America. The actual volume of business passing in the meantime is small, but it seems reasonably certain to assume that a considerable volume of business will eventually be placed here which would in the ordinary course have gone to the Continent or elsewhere. At the same time, hopes are not entertained of an undue expansion of trade, in view of the probability of higher costs and the present state of international trade. Sheet makers have felt an immediate benefit from the change in economic conditions. The importation of sheets from the Continent is practically impossible, and home makers are in a better position to obtain orders abroad. Galvanised corrugated sheets have been advanced to £11 home and £10 per ton export for 24 g., and ordinary black sheets have a firmer tendency. Steel tubes are extremely quiet, and without any indication of early improvement.

Iron.

The bar iron trade still languishes. Prices are maintained, and producers suffer in competition with steel products. Makers of re-rolled steel bars are now faced with increased costs of imported raw materials, and prices of re-rolled steel bars have been increased to £6 10s. per ton, home and export.

Pig Iron.

An improvement in pig iron is anticipated, and it is probable that some furnaces may be restarted, in addition to furnaces just relit in order to furnish supplies for Associated Steel Works. Quantities of pig iron continue to arrive in this district, over 1000 tons being discharged at Bowling last week. Prices remain unchanged. Shipments last week only amounted to 129 tons, compared with 312 tons in the same week last year.

Scrap.

The scrap market continues weak, the demand showing no tendency towards improvement. Cast iron machinery is quoted 46s. and heavy steel 37s. 6d. per ton.

Coal.

The increase in inquiries following the abandonment of the gold standard has not been maintained. The advance in colliery quotations makes it impossible for exporters to entertain forward transactions, and business is still more or less confined to immediate shipments. Fifeshire and Lothians steams are somewhat scarce, and prices of these qualities may appreciate further, though just at the moment the scarcity of prompt tonnage may enable a shipper with spot tonnage available to secure advantageous prices. Lanarkshire ells and splints move steadily. Treble and double nuts in all districts remain firm and singles are a shade stronger. Aggregate shipments amounted to 247,544 tons, against 212,328 tons in the preceding week and 230,115 tons in the same week last year. The home market is featureless.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

As was expected, shipments of coal and coke from this district last week turned out to be more satisfactory than for some time past. It was known that a good supply of tonnage was due to arrive, and the result was that, according to the Great Western Railway Company's returns, the total came to 478,610 tons, which was 76,720 tons better than the preceding week, and only 5976 tons less than for the corresponding period of last year. It is perhaps too much to expect that last week's level will be maintained, though the figures may be found to be not far short. The fact is that at the end of last week the number of idle tipping appliances came to thirty-seven, and as the result of tonnage arrivals over the week-end this figure was reduced to nineteen, while only two steamers were waiting to berth. Furthermore, it is questionable whether outward chartering has been quite so active. Still the position of many collieries is even now better than it has been, so much so that in a few cases they can ask for slight premiums on the schedule of minimum prices for supplies for early shipment. It is questionable, however, whether business is developing as satisfactorily as many hoped for and expected. The disturbed state of countries abroad, their financial position, and the restriction placed by France and Belgium upon imports of coal by the operation of the licensing system, all combine to hold in check commercial operations, whilst, of course, the instability of foreign exchanges accentuates difficulties. In any coal contract business that is negotiated the question of satisfactory payment terms is one that must necessarily arise, and for this reason it will be interesting to see whether an order for 80,000 tons of steam coals for the Brazilian Central Railways comes to South Wales. Tenders go in at the end of this week. The coals have to be delivered at Rio de Janeiro by the end of this year. Another interesting inquiry is that of the Portuguese State Railways for prices for 125,000 tons of small coals for delivery from November to March. The railways also ask for the option of taking 250,000 tons to be delivered from November to July next. Prices on a c.i.f. basis have to be sent in by the 26th inst. An order for 20,000 tons of coke of furnace grades has recently been booked by William Cory and Son, Ltd., with Yugo-Slav buyers, and shipment is now being effected.

Boilermakers' Strike Over.

After a week's duration, the suspension of work on the part of boilermakers in this district came to an end on Thursday of last week. The men presented themselves for work on Friday last on the new terms posted by the employers, which involves a withdrawal of the 5s. bonus to riveting squads employed on piecework, and of 2s. 6d. per week on squads engaged on piecework on work other than riveting or on lieu rates, with a further reduction of 2s. 6d. per week in January next. It was arranged that there should be a meeting between the men's representatives and the employers in the course of the present week to consider the general position. The stoppage of work on the part of the boilermakers, although only of a week's duration, has meant the diversion of a number of steamers from this channel and the loss of ship-repairing work.

Iron, Steel, and Tin-plates.

As mentioned in my last letter, an additional furnace was blown in over last week-end at the Margam Works of the British (Guest, Keen, Baldwins) Iron and Steel Company, Ltd. The Bryngwyn Steel Works bar mill, Gorseinon, was due to restart on Monday last, thus giving employment to 100 men. The works have been closed down for over two years, except for a few weeks' activity in August last year. The Grovesend steel-smelting department has also recommissioned its fifth smelting furnace, which puts the steelworkers on full time. Reports show that substantially increased business has lately been done in pig iron at better prices. The fear of the introduction of a tariff is resulting in increased supplies of steel billets and bars being rushed from the Continent to this country. Tonnage is in active demand for the shipment of supplies.

North Wales Coalfield.

The independent accountants' report on the trading results in the North Wales coalfield for the three months ended August last shows a debit balance of £10,237, equal to 3·23d. per ton. The output during the period was 760,180 tons, and the proceeds £483,942, or 12s. 8·79d. per ton. Wages absorbed £342,671, or 9s. 0·19d., and other costs £151,508, or 3s. 11·83d. The economic wage certified was 98·92 per cent. of the wages paid at basis rates, but under the agreement the miners are entitled to a minimum of 22 per cent. above basis rates, and the payment of this minimum left a deficiency of £75,507, thus increasing the total deficiency carried forward to £4,288,323.

South Wales Trade.

Returns issued by the Great Western Railway Company relating to the trade at the docks in this district under its control for the four weeks ended September 27th show that imports and exports come to a total of 2,071,975 tons, which compares with an aggregate for the preceding four weeks of 2,046,312 tons. Up to September 27th last the aggregate of imports and exports was 20,494,140 tons, which compares with 26,600,227 tons for the same period of 1930.

Current Business.

The slightly better tone prevailing in steam coals is maintained, but except for a few descriptions, supplies of coals are obtainable for early shipment without difficulty. Dry large coals are rather scarce and for prompt loading sellers can in some cases secure up to 6d. above the minima. Sized coals are irregular, but dry qualities are firm. Smalls are freely obtainable. The demand for patent fuel is quiet. French exporters of pitwood continue to load vessels "under protest," there having been no settlement between them and local importers of the dispute arising out of this country going off the gold standard. Inasmuch as other merchants in France have resolved to honour their engagements, the belief is entertained that French exporters of pitwood will finally adopt the same course, and carry out their obligations, just as coal exporters on this side are observing their commitments, though they mean in many cases a financial loss. The price of pitwood remains about 26s. to 26s. 6d.

CONTRACTS.

John I. Thornycroft and Co., Ltd., inform us that the twenty-eight motor lifeboats for the new giant Cunarder, which are being built by Hugh McLean and Sons, Ltd., of Govan, Glasgow, will be fitted with Thornycroft engines of the RA/4 25 B.H.P. type.

Henry Simon, Ltd., Cheadle Heath, Manchester, has received from Weaver and Co., Ltd., the flour millers and grain merchants, of Swansea, an order for a travelling pneumatic grain-discharging plant, capable of discharging at a maximum rate of 180 tons per hour. Steamers lying in the North Dock basin, Swansea, will be discharged by the pneumatic plant, and the grain delivered direct to existing band conveyors, arranged in tunnels below the quay for transfer to Messrs. Weaver's warehouses or flour mills.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Cox and Danks, Ltd., have opened a new office in Birmingham, at Newton Chambers, Cannon-street, where Mr. F. Rollinson, Jnr., from the Manchester office, is the manager.

At the Manchester College of Technology, on October 3rd, Honorary Associateship was conferred upon Mr. K. Baumann, M.I. Mech. E., who is a director and chief mechanical engineer of the Metropolitan-Vickers Electrical Company, Ltd.

Mr. Arthur Ronson, chief constructional engineer of the Furness Shipbuilding Company, Ltd., of Haverton Hill-on-Tees, has been appointed general manager of the Chepstow (Monmouth) constructional works of the Fairfield Shipbuilding and Engineering Company, Ltd.

Edward G. Herbert, Ltd., Atlas Works, Manchester, has appointed John Chambers and Son, Ltd., Fort-street, Auckland, New Zealand, as sole agents in New Zealand for "Rapid" and "Rapidor" sawing machines, saw-sharpening machines, and high-speed steel saw blades.

Mr. George A. Phillipson, M.I. Min. E., who has been technical representative for the Coppée Company (Gt. Britain) Ltd., has joined the Steel Band Conveyor and Engineering Company, Ltd., of Birmingham, to represent it in London and the South for mechanical handling schemes for all industries.

Hollings and Guest, Ltd., Birmingham, are removing the whole of their works to Cardigan Works, Belmont-row, Birmingham. Mr. Guest, who is managing director of this firm, is also managing director of John Hands and Sons, Ltd., of Belmont-row, Birmingham, and it has been decided for the sake of convenience and economy to combine the two businesses.

The Lloyd Triestino Steamship Company.—We are informed by Lloyd Triestino, of 16, Waterloo-place, London, S.W. 1, representing the Cosulich Line, Marittima Italiana Adria Steamship Company, Puglia Steamship Company, and San Marco Steamship Company, that recent reports regarding the change of name of the Lloyd Triestino Steamship Company are erroneous and unfounded. There will be no change in the company's name nor any diminution in its activities as a steamship line.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	16/– to 20/6
(1) Spanish	16/– to 18/–
N.E. Coast—	
Native	18/– to 21/–
Foreign (c.i.f.)	16/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 6 0	3 6 0
No. 1	3 6 6	3 6 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
Midlands—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*); 4 0 6 (*b*); 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 10 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
Lancs.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. Yorks.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6 to 9 0 0	—
Gas Tube Strip	10 10 0 to 10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	9 0 0	—
„ „ (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 10 0	7 10 0
Sheets (Gal. Cor. 24 B.G.)	11 0 0	10 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
Manchester—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 15 0	—
Sheffield—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
Midlands—		
Small Rolled Bars	6 12 6 to 8 0 0	—
Billets and Sheet Bars	5 5 0 to 5 10 0	—
Galv. Sheets, f.o.b. L'pool	9 15 0 to 10 0 0	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 17 6	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14 f.o.b.	14/– to 14/6
Block Tin (cash)	130 5 0
„ (three months)	132 5 0
Copper (cash)	35 15 0
„ (three months)	36 15 0
Spanish Lead (cash)	13 10 0
„ „ (three months)	13 12 6
Spelter (cash)	13 0 0
„ (three months)	13 11 3
Manchester—	
Copper, Best Selected Ingots	42 0 0
„ Electrolytic	43 0 0
„ Strong Sheets	75 0 0
„ Tubes (Basis Price), lb.	0 0 10½
Brass Tubes (Basis Price), lb.	0 0 9½
„ Condenser, lb.	0 1 0
Lead, English	15 2 6
„ Foreign	13 10 0
Spelter	13 7 6
Aluminium (per ton—raw ingot)	£85

FERRO ALLOYS.

		Per Unit.
Tungsten Metal Powder	2/4 per lb.	
Ferro Tungsten	2/– per lb.	
	Per Ton.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 0 0	7/–
„ „ 6 p.c. to 8 p.c.	£24 0 0	7/–
„ „ 8 p.c. to 10 p.c.	£22 10 0	6/6
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£35 0 0	10/–
„ „ „ 1 p.c. carbon	£39 0 0	12/–
„ „ „ 0·70 p.c. carbon	£41 0 0	13/–
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	3/1 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£10 10 to £12 scale 5/– per unit	
„ „ 75 p.c.	£16 to £17 scale 7/– per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£210	
Ferro Cobalt	8/6 per lb.	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/9
„ „ Ell	14/6
„ „ Splint	14/3 to 15/9
„ „ Trebles	14/– to 14/6
„ „ Doubles	13/3
„ „ Singles	10/–
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	17/–
„ „ Trebles	14/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 14/–
Screened Navigation	17/–
Trebles	16/– to 17/–
Doubles	14/– to 14/6
Singles	10/6
Lothians—	
(f.o.b. Leith)—Best Steam	12/– to 12/6
Secondary Steam	11/6
Trebles	15/6 to 16/–
Doubles	14/–
Singles	10/–

ENGLAND.

	Inland.
(8) N.W. Coast—	
Steams	21/–
Household	32/6 to 51/8
Coke	20/– to 20/6
Northumberland—	
Best Steams	14/– to 14/3
Second Steams	12/– to 12/3
Steam Smalls	8/6
Unscreened	12/6 to 13/–
Household	27/– to 39/–
Durham—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/– to 37/–
Foundry Coke	24/–
Sheffield—	Inland.
Best Hand-picked Branch	24/6 to 25/6 —
South Yorkshire Best	23/6 to 24/6 —
Derbyshire Best Bright House	21/– to 22/– —
Best House Coal	21/6 to 22/6 —
Screened House Coal	19/– to 20/– —
Best Screened Nuts	18/– to 19/– —
Small Screened Nuts	16/6 to 17/6 —
Yorkshire Hards	17/– to 18/6 —
Derbyshire Hards	17/– to 18/6 —
Rough Slacks	9/6 to 10/6 —
Nutty Slacks	7/6 to 8/6 —
Smalls	5/6 to 6/6 —
Blast-furnace Coke (Inland)	10/– on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 14/– to 15/–	

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	19/6
Second Smokeless Large	18/6 to 19/6
Best Dry Large	19/– to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/–
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/– to 13/6
Ordinary Smalls	11/– to 13/–
Washed Nuts	18/– to 21/–
No. 3 Rhondda Large	19/9 to 20/–
„ „ Smalls	15/– to 16/–
No. 2 „ Large	17/– to 17/3
„ „ Through	15/6 to 16/–
„ „ Smalls	14/– to 14/3
Foundry Coke (Export)	22/– to 36/6
Furnace Coke (Export)	15/6 to 16/–
Patent Fuel	19/– to 19/9
Pitwood (ex ship)	26/– to 26/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	36/– to 38/6
Seconds	27/– to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/–
Nuts	40/– to 46/–
Beans	24/9 to 28/3
Peas	21/– to 22/–
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/–
Steam Coals:	
Large	20/– to 20/6
Seconds	18/– to 20/–
Smalls	11/6 to 13/–
Cargo Through	16/– to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/– if home consumers confine purchases from associated British Steel Makers. Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

A Trade Dilemma.

WHATEVER may be the effect upon British trade of the lower value of the pound, there is no doubt that it has a disconcerting influence upon the Continent, where money no longer fulfils its normal functions and business has, therefore, fallen to the lowest ebb. In France, the situation is not so good as it is made to appear on the surface. The official figures of unemployment are small, and do not represent the actual number of men out of work, which is growing steadily. The rapidly contracting export trade, falling railway traffic receipts, lack of credits and Budget difficulties, are indications of bad times, and the amount of business done in the engineering industries is certainly less than one-half of what it was some months ago. The mainstay of the industry has long been provided by home and colonial public works, railway rolling stock and State contracts. All these sources of activity have dwindled and there is now no money for undertakings except the credits that were granted some time ago for colonial and other enterprise. Work at the ports is being held up through lack of funds. At a meeting of the Association des Grands Ports Français last week, Monsieur Watier, Director of Ports and Inland Waterways at the Ministry of Public Works, stated that the programme of harbour works necessitated an expenditure of 250 million francs a year, and that the Government was unable, under present conditions, to increase the existing credit of 100 millions. Therefore, the only means of continuing the undertakings and reducing unemployment was to obtain loans. The Association also reported upon the bad effect the restriction of coal imports was having upon the activity of the ports, and urged the Government to suppress the licence system. That system has not done much to benefit the home colliery industry, for the miners are appealing to the Government to take other measures to prevent the discharge of men.

Rail Motor Cars.

Monsieur Dautry, General Manager of the State Railways, has published his ideas on the subject of railway reform. They follow very closely the general scheme that is being considered by all the railway companies. He affirms that there can be no better means of transport than the railway for heavy traffic, and the experience of the local line between Caen and Laval, which was saved by the use of rail motor cars, shows the value of frequent and quick services of such vehicles for dealing with light traffic. The first of a series of ten cars, with 80 horse-power solid injection engines, carrying thirty-four passengers, was put into service at the beginning of the year. Compared with the steam locomotives previously employed, the cost per kilometre has been reduced from 10f. to 2·5f., and the average speed increased from 20 to 34 miles an hour. During the first eight months the number of passengers carried increased from 272 to 851 per day. Monsieur Dautry takes as an example of what can be done the line between Paris and Brest, upon which there would be only two *rapides* each way, one during the day and one at night, except during the summer months. The general service would be effected by a number of motor coaches running at from 62 to 75 miles an hour and stopping at Chartres, Le Mans, Laval, Rennes and Saint-Brieuc. Intermediate stations would be served by other self-propelled coaches travelling at an average speed of from 50 to 55 miles an hour. All the stations would be in communication over wide areas with road motor cars. Monsieur Dautry says that this reform could be carried out in five years. The Conseil Supérieur des Chemins de Fer favours the use of rail motors as a solution of the problem of working local railways with small traffic. The P.L.M. Company has requested builders to submit plans of a type of car with a heavy-oil engine that could be easily removed without taking down any part of the chassis. The car must have a seating capacity for forty passengers and standing room for ten, and must carry a ton of luggage. The speed should be 56 miles an hour on the level, and 37 miles on a gradient of 15 mm. per metre. At the maximum speed it must be stopped on a down gradient of 5 mm. per metre in 120 m. The pneumatic-tired rail-bus is regarded as offering great possibilities in the way of fast and comfortable travelling, but during the past week an unfortunate accident happened to a rail-bus which had started on a series of official trials between Troyes and Bar-sur-Aube. When travelling at a high speed, one of the front wheels came off and was projected forward with considerable velocity, while a part of the broken flange tore through the floor of the car and narrowly missed a passenger. The car was stopped without further damage.

The Navy.

The Government is endeavouring to effect economies in the naval programme without curtailing the tonnage or lowering the efficiency of the service, and with that object in view the Minister of Marine has made a tour of inspection of the ports and arsenals, following upon which he states that a more economical organisation has enabled him to prepare a programme whereby the estimates for the next four years will be reduced from the original 170 million francs to 90 million francs. Special attention will be given to the protection of the ports in view of the longer range of naval guns, and of the danger of attack from aircraft. At Brest the Minister inspected the new training ship "Jeanne d'Arc," which will shortly leave for her first cruise around South America. This is the first ship especially constructed for training purposes, and since the old "Bordas" went out of commission many years ago, the cadets have had their training on shore. The "Jeanne d'Arc" is a cruiser of 7240 tons displacement. She has a length of 160 m. between perpendiculars and a width of 17·7 m. There are four twin turrets with 155 mm. guns, as well as anti-aircraft and machine guns and two seaplanes. There are two independent groups of geared turbines, giving a cruising speed of 19 knots, and during the eight-hours' trial the speed exceeded 27 knots.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

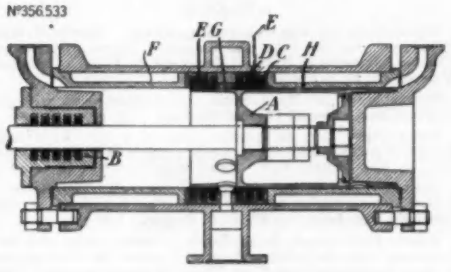
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM ENGINES.

356,533. October 15th, 1930.—CYLINDER AND PISTON PACKING FOR PRIME MOVERS, Hannoversche Maschinenbau-Actiengesellschaft, vormals Georg Egestorff (Hanomag), of Hannover-Linden, Germany; and Rudolf Wichtendahl, of 17, Adelheidstrasse, Hannover, Germany.

This specification describes an arrangement for obtaining a tight joint between a piston and cylinder wall without the employment of piston rings, but with packing rings in the

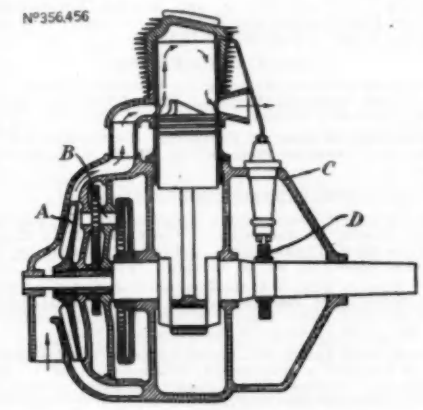


cylinder. A indicates the piston, B the piston-rod packing. Piston rings C are arranged in grooves of casing rings D so that the lubricant may be easily supplied from the exterior through passages E, the piston having a smooth surface. In order to reduce the friction between the piston and the packing rings, the piston may be made of chrome-nickel steel and the packing rings of bronze. The cylinder sleeve consists of three parts F G and H. Only the middle section G of the cylinder sleeve supports the piston.—*September 10th*, 1931.

INTERNAL COMBUSTION ENGINES.

356,456. August 27th, 1930.—SUPPLY OF FUEL TO TWO-STROKE RADIAL CYLINDER DIESEL ENGINES, Siemens und Halske Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

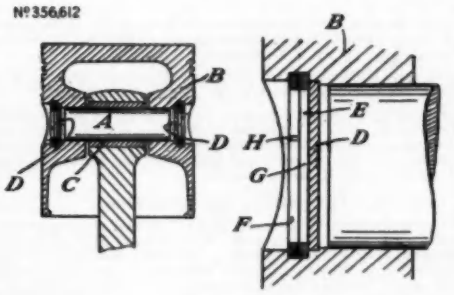
This specification describes a fuel supply arrangement for Diesel engines of the two-stroke radial cylinder type. For the sake of simplicity the drawing shows one cylinder in vertical section of a two-stroke Diesel engine having radially arranged



cylinders. The scavenging and charging air is supplied by means of a blower A which is driven through gearing B from the crank shaft. A fuel pump C is associated with the cylinder, there being one pump for each cylinder. All the fuel pumps are arranged radially and in the same plane and are controlled by one single cam D, which is carried on the crank shaft.—*September 10th*, 1931.

356,612. December 31st, 1930.—TRUNK PISTONS, Thomas Craig English, of Harland and Wolff, Ltd., Queen's Island, Belfast; and Frederick Ernest Rebbeck, of the same address.

Improved means of limiting the end movement of the floating gudgeon pin of a trunk piston and means for preventing or

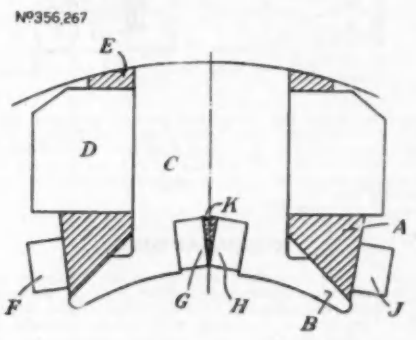


minimising the escape of lubricating oil from the surface of the gudgeon pin to the cylindrical surface of the piston are described in this specification. The gudgeon pin A is free to turn in the bosses B and may also be free to turn in the connecting-rod eye C. Alternatively, the gudgeon pin may be fixed to the rod in any well-known manner. The gudgeon pin is limited as regards end movement by discs D, which also prevent or minimise the escape of lubricating oil. In this particular arrangement the discs D abut against shoulders in the bosses B and are held in place by outwardly expanding rings E and F accommodated in a single groove in the boss B. The ring E abuts against the disc D and one side of the groove, and is made of such diameter that when sprung into the groove, the butt joint G is closed, making an approximately oil-tight joint. The second ring F is sprung into the groove behind the ring E, but the joint H of this ring does not necessarily make an oil-tight joint, as its purpose is simply to prevent movement of the ring E.—*September 10th*, 1931.

DYNAMOS AND MOTORS.

356,267. June 6th, 1930.—D.C. DYNAMO-ELECTRIC MACHINES, Kenneth William Dryburgh Roberts, of 42, Auburn-road, Old Trafford, Manchester, and Associated Electrical Industries, Ltd., of Bush House, Aldwych, Westminster.

According to this invention the compensating winding is not distributed over the whole face of the pole in the usual way, but is composed of two coils, one surrounding each half of the pole face and hugging the pole horn. The adjacent sides of the two coils are included in a single slot, or in a pair of neighbouring slots extending along the middle of the pole face parallel with the armature shaft. Shaped wedges A engage the chamfered portions of the pole horns B, and the intermediate portion or stem of the pole C, as shown. The wedges A constitute seatings

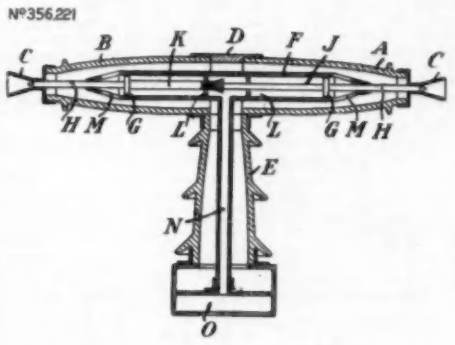


for the main field coil D, which is separated from the yoke by distance pieces or packing strips E, which will usually be resilient. The compensating winding comprises two coils made up of the coil sides F, G, H and J, connected at their ends. The outer coil sides F and J engage, along their inner surfaces, with the wedges A, so as, in effect, to hug the pole horns B, while the inner or adjacent coil sides G and H are accommodated in a single slot extending along the middle of the pole face parallel with the armature shaft. The slot in which the coil sides G and H are disposed is widened towards the back. A substantially triangular wedge K inserted between the coil sides G and H in the slot serves securely to hold the coil sides in the slot, and, together with the wedges A, serves to secure the coils in position.—*September 7th*, 1931.

SWITCHGEAR.

356,221. June 4th, 1930.—ELECTRICAL SWITCHES WITH MEANS FOR EXTINGUISHING THE ARC BY GAS UNDER PRESSURE, Sigwart Ruppel, of 8, Palmengartenstrasse, Frankfurt a.M., Germany.

This invention relates to electric switches of the kind provided with means for extinguishing the arc by gas under pressure. The switch chambers formed of the insulators A and B and the contact nozzles C are placed horizontally opposite one another. The insulators are fixed on the supporting piece D, which is carried by the hollow support E. A tube F of insulating material is fixed in the casing formed by the switch chambers, and forms a cylinder in which the pistons G move and serve to actuate the movable contacts or switch pins H. Electrical



connection of the two switch pins is provided by the tube J and the tubular contact K. Stops L are arranged in the pipe F for limiting the stroke of the pistons. The tube F has cross pieces with apertures M extending backwards from the nozzles, and through which the pressure gas necessary for opening the switch passes from the switch chamber to the appropriate side of the pistons. The pressure gas for closing the switch is supplied through the insulating pipe N, from the space O in the foot of the switch. The pressure gas for the blast and for opening the switch, passes through the pipe N into the switch chamber, and flows through the openings M behind the pistons. The device for producing a uniform motion of the two switch pins is not shown.—*September 4th*, 1931.

FURNACES.

356,422. August 8th, 1930.—MELTING FURNACES, Karl Wirges, of 296, Kalker Hauptstrasse, Köln-Kalk, Germany.

The invention relates to melting furnaces fired with coal dust, and of non-circular cross section. In the drawings A is the hearth space of elliptical cross section, B is the unlagged furnace wall, C are the charging openings in the longitudinal sides of the furnace. D is the tapping opening, which can be, as desired, below or above the charging opening or opposite on the rear of the hearth space, as shown by the dotted lines in Fig. 3. The furnace is provided with circular runners E, which run on rollers F, which can be set in rotation through any kind of driving gear G, the furnace then being rotated on a longitudinal axis. H is the coal dust burner operated with low air pressure. The burner is arranged to feed the coal dust longitudinally through one end

of the furnace. The furnace is turned through about 180 deg. for mixing, so that the ellipse passes from the horizontal position —Fig. 2—to the vertical position—Fig. 3—and finally to the opposite horizontal position. The bath therefore flows in succession over different parts of the elliptical cross section. The

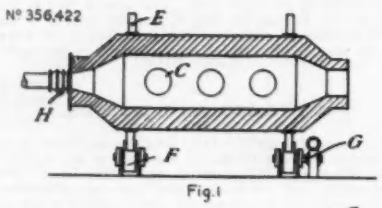


Fig. 1

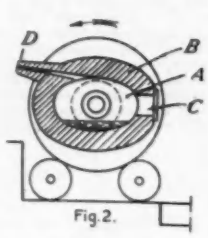


Fig. 2.

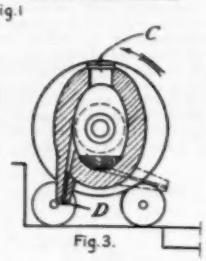


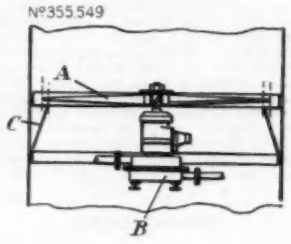
Fig. 3.

spread out bath—Fig. 2—is thus strongly gathered together —Fig. 3—and finally again spread out. The furnace is then turned back when the bath again flows over the different parts of the cross section. By turning to and fro through about 180 deg. mixing can be carried to a degree not hitherto reached.—*September 10th*, 1931.

MISCELLANEOUS.

355,549. September 22nd, 1930.—Induced Draught Fans, Schmidt'sche Heissdampf-Gesellschaft, mit beschränkter Haftung, Rolandstrasse 2, Cassel-Wilhelmshöhe, Germany.

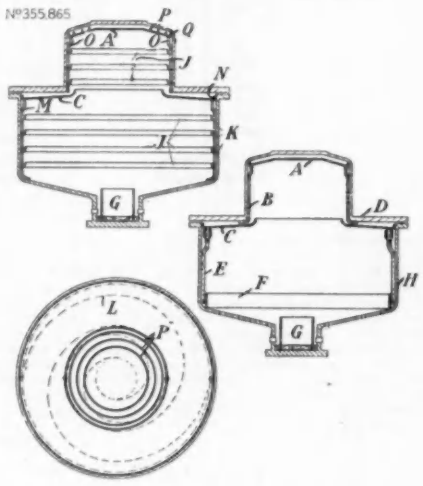
This invention is concerned with induced draught fans, especially those installed in the funnels of steamers, and is said, in the case of fans of, say, 2·4 m. diameter, to increase their efficiency by as much as 20 per cent. The fan A is of the aero



propeller type and is driven by the steam turbine B. It is necessarily smaller in diameter than the uptake on account of temperature changes producing distortion. Ordinarily the clearance would materially reduce the efficiency of the fan, so a cone C is arranged below it and has a diameter slightly less than that of the fan blades, to guide the gases into the fan.—*August 27th*, 1931.

355,865. June 18th, 1930.—Mercury Vapour Rectifiers, The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C. 2., and Enrico Gallizia, of the General Electric Company, Ltd., Engineering Works, Witton, Birmingham.

The chief object of this invention is to lessen or remove the danger of reverse arcing in rectifiers due to falling drops of condensate. Mercury condensing on the top of the condensing chamber falls on to the drip shield A, and from there flows down the pipes B to the drip shields C. Mercury condensing on the side walls of the condensing chamber or on the top plate D falls directly into the drip shield C. Mercury flows from the drip shield C down the pipes E, under the baffle F, across the



bottom surface of the tank and so to the cathode G. Mercury condensing on the walls of the tank H flows to the cathode under the baffle F. A number of annular gutters J are secured to the walls both of the condensing chamber and of the tank. These gutters are arranged one below the other, in such a way that mercury condensing on the walls flows into the gutter immediately below the point where the mercury condenses. In some cases it may be preferable to have a non-uniform spacing of the gutters. Each gutter is provided with outlet pipes K, which, in the case of most of the gutters, lead to the gutter below; but, in the case of the bottom gutter in the condensing chamber, the outlet pipes lead direct to the drip shield C, and in the case of the bottom gutter in the tank the outlet pipes lead to the bottom surface of the tank H. These latter pipes have their outlets arranged in such a way that mercury flowing therefrom flows in spirals L to the cathode G. The drip shield C is provided with outlet pipes M, which lead to the top gutter in the tank, and, as in the previous case, is provided with an upright flange N. The drip shield A is provided with outlet pipes O, which lead to the top gutter in the condensing chamber, and, as in the previous case, is provided with an upright flange. The drip shield A is also provided with three perforated baffles P, which constrain the outward flow of the mercury across the shield and tend to prevent it splashing over the flange Q.—*September 3rd*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the time and place *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Electrical Engineers: North-Eastern Students' Section.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. Chairman's address, Mr. E. N. Cunliffe. 7.15 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster. Special General Meeting. By-laws. 6 p.m.

Institution of Municipal and County Engineers: North-Western District.—Visit to works of G. and T. Earle, Ltd., at Hope, Derbyshire. Leave Manchester 11.15 a.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Informal meeting. "The Characteristics of Commercially Pure Iron," by Mr. C. C. Berger. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—In the Lecture Theatre, Literary and Philosophical Society, Newcastle-upon-Tyne. Annual general meeting. Presidential address by Mr. John McGovern. 6 p.m.

Overhead Lines Association.—At the Georgian Restaurant, Harrods, Ltd., Knightsbridge. Conversazione. 8 p.m. to midnight.

Physical Society.—At the Imperial College of Science, Imperial Institute-road, South Kensington, S.W. 7. Meeting at 5 p.m.

University of London.—At the Institution of Electrical Engineers, Victoria Embankment, London, W.C. 2. Advanced Lecture in Engineering, "The Measurement of Light: Its Basis and its Significance," by Mr. E. C. Crittenden. 5.30 p.m.

West of Scotland Iron and Steel Institute.—Royal Technical College, George-street, Glasgow. Presidential address by Mr. John Bird. 7.15 p.m.

SATURDAY, OCTOBER 17TH.

Institution of Civil Engineers: Manchester and District Association.—Visit to Clarence Dock Power Station, Liverpool. Leave Manchester, Victoria Station, 1.35 p.m., meeting at Power Station, 2.30 p.m.

Institution of Municipal and County Engineers.—Southern District meeting at Newbury. Assemble in Council Chamber, Municipal Buildings, 11.15 a.m.

MONDAY, OCTOBER 19TH.

Bradford Engineering Society.—In the Hall of the Technical College, Bradford. Lecture, "Michael Faraday," by Mr. W. H. N. James. 7.30 p.m.

Institution of Sanitary Engineers.—Caxton Hall, S.W. 1. "The Rural Sewerage Problem," by Mr. W. O. Humphery. 7 p.m.

TUESDAY, OCTOBER 20TH.

Illuminating Engineering Society.—At the Lighting Service Bureau, 15, Savoy-street, Strand, W.C. 2. A Report on Progress in Illuminating Engineering, prepared by the Technical Committee, will be presented. 7 p.m.

Institute of Fuel.—At the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Presidential address, Sir Hugo Hirst, Bart. Paper, "Selected Problems Relative to the Coal Industry," by Mr. B. Pochobradsky. 6 p.m.

Institute of Industrial Administration.—In the Lecture Hall of Institute of Hygiene, 28, Portland-place, W. 1. Discussion on "Fundamentals of Market Research," opened by Mr. F. W. Isern-Smith. 6.30 p.m.

Institute of Transport.—At the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Lecture for graduates and students, "Some Present Limitations in the Transport of Freight Traffic by Railway, with Suggestions," by Mr. H. W. Payne. 6 p.m.

Institution of Electrical Engineers: Scottish Centre.—In the Engineers' Rooms, 39, Elmbank-crescent, Glasgow, C. 2. Chairman's address, Professor G. W. O. Howe. 7.30 p.m.

Institution of Electrical Engineers: South Midland Students' Section.—At the Grand Hotel, Colmore-row, Birmingham. Chairman's address, Mr. S. C. Dinenage. 7 p.m.

WEDNESDAY, OCTOBER 21ST.

Institute of Fuel.—At the Connaught Rooms, Great Queen-street, London, W.C. 2. Annual dinner. 6.45 for 7.15 p.m.

Institution of Production Engineers: Birmingham Section.—Grand Hotel, Birmingham. "Control of Factory Production," by Mr. T. G. Heckles. 7 p.m.

Royal Microscopical Society.—Hastings Hall, B.M.A. House, Tavistock-square, W.C. 1. Meeting at 5.30 p.m.

Society of Glass Technology.—Science Museum, South Kensington, S.W. 7. Opening of Exhibition of Modern Technical and Artistic Glasses by Sir Richard Gregory, Bart., 4 p.m. General meeting. Presidential address, "The Future of Glass Melting," by Mr. E. Meigh. 8 p.m.

THURSDAY, OCTOBER 22ND.

Co-ordinating Committee Representing Staffordshire Iron and Steel Institute, Birmingham Metallurgical Society (Inc.), and Birmingham Local Section of the Institute of Metals.—In the English Lecture Theatre, the University, Edmund-street, Birmingham. "Industrial Policy," by Sir William Larke, K.B.E. 7 p.m.

Institute of Fuel.—At the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. "Marine Reciprocating Steam Plants: Some Outstanding Factors of Economy," by Mr. Alrik Björklund. 6 p.m.

Institution of Electrical Engineers.—Victoria Embankment, London, W.C. 2. Presidential address by Captain J. M. Donaldson. Presentation of Premiums. 6 p.m.

Institution of Mining and Metallurgy.—At the Rooms of the Geological Society, Burlington House, Piccadilly, London, W. 1. "Some Features of Lead Blast-furnace Operations at the Works of the Broken Hill Associated Smelters Proprietary, Ltd., Port Pirie, South Australia," by Mr. O. H. Woodward; "Note on the Use of Bore-hole Pumps for Mine Drainage," by Mr. L. C. Stuckey. 5.30 p.m.

Institution of Structural Engineers.—10, Upper Belgrave-street, S.W. 1. "Modern Research on the Nature of Materials of Construction (Steel and Concrete)," by Mr. Harry Jackson. 6.30 p.m.

FRIDAY, OCTOBER 23RD.

Faraday House Old Students' Association.—At the Savoy Hotel, Strand, W.C. 2. Twenty-third annual dinner.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W. 1. Presidential address by Lieut.-Colonel E. Kitson Clark. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Informal meeting. "Some Instruments Used in Connection with Power Plant," by Mr. I. Fagelston. 7.30 p.m.

MONDAY, OCTOBER 26TH.

Institution of Mechanical Engineers: Graduates' Section.—Storey's-gate, St. James's Park, S.W. 1. "The Manufacture of Wire," by Mr. W. W. S. Robertson. 6.45 p.m.

FRIDAY, OCTOBER 30TH.

Institution of Chemical Engineers.—In the Lecture Theatre of the Institution of Civil Engineers, Great George-street, S.W. 1. "Hydrogenation," by Dr. E. F. Armstrong, F.R.S. 6.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W. 1. Informal meeting. Discussion on "Engineering in Agriculture," to be introduced by Mr. R. Borlase Matthews. 7 p.m.

Institution of Mechanical Engineers: East Midland Branch.—University College, University Park, Nottingham. Chairman's address, "The Importance of Metallurgy to the Engineer," by Professor C. H. Bulleid. 6.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "Automatic Combustion Control," by Mr. S. J. Clifton. 7.30 p.m.

SATURDAY, OCTOBER 31ST.

Co-ordinating Committee Representing Staffordshire Iron and Steel Institute, Birmingham Metallurgical Society (Inc.), and Birmingham Local Section of the Institute of Metals.—In the Warwick and Dudley Rooms, Queen's Hotel, Birmingham. Annual dinner and dance. 7 p.m.

Hull Association of Engineers.—In the Municipal Technical College, Hull. "Combustion and Boiler-house Efficiency," by Mr. J. N. Waite. 7.15 p.m.

Institution of Production Engineers.—Grand Hotel, Birmingham. Annual dinner. 7 p.m. for 7.30 p.m.

MONDAY, NOVEMBER 2ND.

National Institute of Industrial Psychology.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Recent Research into the Causes of Industrial Accidents," by Mr. Eric Farmer. 6 p.m.

FRIDAY, NOVEMBER 6TH.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W. 1. Thomas Hawksley Lecture, "The Mechanical Aspects of Electricity," by Mr. Llewellyn B. Atkinson. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "The Cooling of the Crude Oil Engine," by Mr. A. P. Quarrell. 7.30 p.m.

MONDAY, NOVEMBER 9TH.

Institute of Transport.—At the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Annual general meeting. Paper, "The Influence of Transport on Regional Planning," by Mr. J. Paterson. 5.30 p.m.

National Institute of Industrial Psychology.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Recent Research into the Causes of Industrial Accidents," by Mr. Eric Farmer. 6 p.m.

FRIDAY, NOVEMBER 13TH.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Annual general meeting. 7.30 p.m.

MONDAY, NOVEMBER 16TH.

National Institute of Industrial Psychology.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Recent Research into the Causes of Industrial Accidents," by Mr. Eric Farmer. 6 p.m.

TUESDAY, NOVEMBER 24TH.

Institution of Electrical Engineers: Scottish Centre.—At the Grosvenor Restaurant, Gordon-street, Glasgow. Annual dinner. 6.30 p.m. for 7 p.m.

Slide Rule for Sheet Metal.—We have received from F. J. Edwards, Ltd., 406, Euston-road, London, N.W. 1, an all-metal slide rule, which will be found useful amongst sheet metal workers and others for rapidly calculating the weight of steel plate sheets and flat bars. We understand that any of our readers will be presented with one of these rules free on request.

School of Engineering and Navigation, Poplar.—In view of the forthcoming general election, Prince George has decided that he cannot undertake any official functions during the month of October. The opening ceremony of the extension of the London County Council's School of Engineering and Navigation in High-street, Poplar, which His Royal Highness had consented to perform on October 21st next, has accordingly been postponed to Wednesday, November 18th, 1931, at 4 p.m.

L.N.E.R. Signal Installation.—The L.N.E.R. Company has placed a contract with the British Power Railway Signal Company, Ltd., for the resignalling of 30 miles of the main East Coast route tracks between York and Northallerton. This is believed to be the largest signal contract let by any British railway for some years. The contract includes the supply and installation of the latest and newest type of automatic and controlled searchlight and colour light signals and constant-current track circuits with phase adjustment on the stretch of line, which consists of three and four tracks. Also included is an important power signalling installation at Thirsk with remote control. Reversible working will be installed between Sessay Wood and Aine, whilst approach lighting will be provided on automatic signals throughout. By this system passing trains will light up and switch off their own signal light. Electro-mechanical frames will also be installed at intermediate points. The whole of the material to be used will be of British design and manufacture and British labour only will be employed. The British Power Railway Signal Company, Ltd., which is undertaking the installation, will obtain part of the apparatus from the Siemens and General Electric Railway Signal Company, Ltd., and cables from Siemens Bros., Ltd.